NATURE

Vol. 143 SATURDAY, JUNE 10, 1939 No. 3632

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Editorial and Publishing Offices:
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Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London
The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

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Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 143 SATURDAY, JUNE 10, 1939 No. 3632

Planning in House and City

WHILE we may acquiese in the necessity at the present time of concentrating effort on the gigantic task of national defence, we are nevertheless acutely aware that much is seriously amiss with a civilization in which such use of scientific effort should be necessary. On the credit side, however, it will be granted that the importance of social factors in industrial and national problems is widely recognized both within and without the ranks of scientific workers themselves, and the necessity for reorientation of research effort between the biological and social sciences and the physical sciences now appears to command general assent. There are, moreover, indications that at last some of the new powers that science has put at our disposal are beginning to find expression in ways appropriate to their purpose and less dominated by traditions or ideas of the past. True it is that the development of aviation remains warped by military ideas and demands, but the development of the motor-car, for example, is at last finding expression in its own appropriate forms rather than those dictated by the functions or purpose of the horse-drawn vehicle. Similarly in architecture, there have been some striking examples of the use of the newer materials, free from limitations imposed by traditional ideas or practice.

None the less, it has to be admitted that progress on the whole has been comparatively slight, and it is in the changed attitude to new ideas rather than in actual achievement that the strongest reasons for hope are to be found. When, for example, such a radical proposal as the removal of population from a derelict area like that of Merthyr Tydfil to an entirely new but more suitable site, which offers the community a prospect of economic development, can be seriously considered instead of being derided or rejected out of hand, progress is being made. The keen interest which is being taken in the location of industry has, of course, been stimulated by the PEP report and by the evidence given before the Royal Commission on the Geographical Distribution of the Industrial Population, but these two inquiries are really the outcome of public consciousness of the importance of this problem.

There are, however, few, if any, problems arising out of the transformation of industry and society under the influence of mechanical science, in which there is greater need for bold and radical action and for the discovery of more appropriate forms of expression for the new forces at our disposal, than in those arising out of the housing of the community, whether in the aspect of building, town planning, the location of industry or provision of services and amenities.

An imaginative contribution to fundamental thinking about the whole problem of the modern city, whether from the point of view of amenities, industry, defence or housing, has been provided by Mr. Lewis Mumford in "The Culture of Cities"*. He makes a strong plea for casting aside all preconceived ideas and for a determined attempt to think out the real purposes which a city, whether as a whole or in the individual units of houses, is intended to serve in the conditions of to-day and with the resources which are at our disposal.

Even those who do not instinctively recognize that, in this way alone is possible a scientific approach to the problem of really effective planning, cannot but be impressed by the picture

* The Culture of Cities. By Lewis Mumford. Pp. xii+586+32 plates. (London: Martin Secker and Warburg, Ltd., 1938.) 21s. net.

which Mr. Mumford gives of the evils which have in the past resulted from unco-ordinated development, the clinging to obsolete methods of construction or attempting to force new materials into the forms used for earlier products and other purposes. Again and again, advances of earlier generations have crystallized in hard forms which prove intractable obstacles to the progress of later generations, and rob them of many of the advantages placed within their reach by progressive knowledge.

The appeal which Mr. Mumford makes in his latest book is for vision and a sense of values. He would have us examine the institutions which make up city life, from the individual household to the school, the scientific society, the church, and determine the exact functions which they are required to fill in the light of medical knowledge to-day, the advances in means of communication, whether of transport or in such fields as the telephone or broadcasting. Too often we maintain forms or institutions long after the needs for which they were originally created have disappeared or are met more effectively in some other way.

It is easy to overlook the exact social significance of some of these changes. Until, however, we realize that the new means of transport and power production, with the telegraph, the telephone, the radio, the teleprinter and television, have enlarged the sphere of activity and at the same time diminished the need for physical movement and close settlement, we cannot begin to determine accurately the functions and needs of city life; and time, energy, money, and human vitality will continue to be expended in activities of no intrinsic value, as in the crowded transport systems of every metropolis and even in other public services such as water and sewage disposal.

Clear-cut conceptions of the purposes our institutions are to serve in this age, not merely in the age in which they were originally designed, form the basis of adequate planning. Of the dwelling-house we must recognize, as Mr. Mumford points out, that certain of its functions, though domestic in origin, may be better served by communal institutions; for example, child-birth and the care of infective illnesses, weddings and funerals. Other functions, notably on the recreational side, have gained in importance, through the advent of radio, television and the telephone, and will continue to do so as leisure develops. When we have agreed on the exact functions which the modern dwelling-house is intended to serve, we can begin its rational design and eliminate many of the conventional requirements which no longer serve these functions. Moreover, we shall then be free to form an unbiased judgment as to the use which can be made of the new materials at our disposal, the possibilities in the way of fabrication of floors, roof and the walls, and the proportioning of mechanical services or utilities and space or storage.

Treatment of the housing problem along such lines as these demands creative as well as scientific thought. Vision and some ordered conception of family and civic life are also demanded, and this is no less true of other civic institutions such as the school, the church, the public assembly hall, the library, and the scientific or literary society. Definite objectives must be visualized in the provision of the best possible environment for human nuture and culture, the priority of consuming and creative activities over mechanical processes and the expression of vital standards in terms of leisure, health, biological activity, æsthetic pleasure and social opportunity. One of the great dangers of the present moment is that the opportunities which the necessities of defence impose upon us of altering both the design and construction of towns and cities should be missed or stereotyped for lack of imagination.

Mr. Mumford, discussing the new functions of the city, suggests that under the new conditions it should become, as it has often been in the past, the chief instrument of education, and that what should distinguish the new community is not so much the introduction of any essentially new institution as their adequate organization and incorporation as an essential part of the whole. He urges accordingly that cities should be deliberately designed to serve those purposes, and that their size should be a function of the social relationship to be served.

Essentially we have here a positive conception, in place of the merely negative one, which has already led to the recognition that definite steps must be taken to prevent the continued industrial expansion warping or enfeebling the life of the rest of the country. Moreover, it is a conception which guides the planning of the whole of society. Economy must be a regulating principle in all design, for it is only by saving on the means and instruments of life that a community can command the necessary abundance at the higher levels of art, science and education. A modern plan must embrace every human need appropriate to the

structure without waste of space, duplication, or clumsy and indifferent means of circulation.

It follows from this that a first task in the planning and survey required is to educate citizens, to give them the tools of action and to prepare the stage as well as to suggest the socially significant objectivities. Ultimately, this is an essential duty of every school and especially every university. With it there must go the further utilization of science through the regional survey, regional exploration and regional construction, if we are to increase the area of rational human control. Nor should our inability to devise at once the appropriate structure for our civilization, as Mr. Mumford further reminds us, be a cause for permanent discouragement. Most of the forces working towards international co-operation are young, while the opposing forces are old and deeply ingrained in institutions and organizations. A generation is too short a space of time for the reorganization of modern society, whether within or across national frontiers.

If therefore we should not be too readily discouraged at the rate of progress, the problem is too urgent for any opportunity to be neglected. Even while citizens are being educated to appreciate the need for imaginative reconstruction, further obstacles to progress are continually crystallizing out, amenities are disappearing and the problem threatens to become more formidable and intractable. The Bressey report on Highway Development Survey (Greater London) provides already a classic example of the consequences of procrastination or neglect in such matters. Scientific workers undoubtedly have a great part to play in the development of the new and appropriate forms in which the forces they have placed at man's disposal can be utilized for the most effective service of the needs of the community. The achievement of that ideal of fitness for the purpose demands equally, however, the co-operation of art and the humanities, and we may well hope that the very urgency of the present threats to all the richest treasures of our heritage may yet stimulate that co-operation, and issue in the creative expression of a new culture worthy to be compared with any recorded in the long history of mankind.

History and Scientific Endeavour

The Cambridge Ancient History

Vol. 12: The Imperial Crisis and Recovery, A.D. 193–324. Edited by Dr. S. A. Cook, F. E. Adcock, M. P. Charlesworth, N. H. Baynes. Pp. xxvii+849. 35*s*. net. Volume of Plates 5. Prepared by C. T. Seltman. Pp. xv+243. 15*s*. net. (Cambridge: At the University Press, 1939.)

THE issue of the twelfth and last volume of the Cambridge Ancient History is so notable an event that a word must be said about the whole enterprise and the way in which the two ancient universities of Great Britain have divided the work of learning between them. Something must also be added, more especially appropriate to this review, about the point of view from which the man of science is inevitably driven to regard the study of history as a whole.

First as to Oxford and Cambridge. While Cambridge has been elaborating this series of forty volumes on ancient, medieval and modern history, Oxford has given us the standard dictionary of the English language and has just completed a revised and enlarged Greek dictionary based on and improving the traditional "Liddell and Scott". Of these works we have nothing to say at the moment, except that the division of labour speaks well for the co-operation of the two learned bodies concerned and throws a cheering light on the industry and power of organization of both.

The histories which Cambridge has just completed have also a memorable connexion with one of the most learned men whom Great Britain has ever produced. Lord Acton, in 1896, the year after his appointment as regius professor of modern history at Cambridge, was approached by the syndics of the University Press with a suggestion that he should undertake the direction of a history of the world. They can proudly claim that the idea first came from them. Acton replied modestly that such a work was beyond the capacity of any one man. A syndicate of learning was the only conceivable method; but before the end of that year he had himself accepted the editorship of the modern section and had drawn up a plan which the Press approved. He got together a team of assistant editors and contributors and impressed them with his ideals. He died in 1902, the year of the appearance of the first volume. The last of the twelve appeared in 1910, and became at

once the standard book of reference which it has ever since remained. But the wider idea had already taken root and Prof. Bury undertook the planning of a Cambridge Medieval History, of which the first volume appeared in 1911, the year after the completion of the 'Modern' work. 'Modern', it should be understood, begins with the Renaissance and 'Medieval' with the death of Constantine. Owing to the Great War and the death of several of its editors, the Medieval History was not completed until 1936. During its publication, Prof. Bury, with the help of Profs. S. A. Cook and F. E. Adcock, had begun on the third section—the 'Ancient'—which though the earliest in the date of its contents, thus turned out, rather by accident, to be the latest in publication. Its first volume, however, appeared in 1923, thirteen years before the 'Medieval' was finished. It has taken altogether sixteen years to bring the work to a conclusion in the volume which has just been issued. Again, as in the case of Acton, the editor-in-chief of the Ancient and Medieval sections did not live to see his work completed. Dr. Cook's name stands first among the four who have brought the great undertaking into port.

Clearly it is impossible to review in a short space even the fortieth part of this colossal work. One can only mention that this twelfth volume of the ancient history deals with the last hundred and thirty years of the history of imperial Rome before the triumph of Constantine which ushered in the triumph of the Christian Church, marked by Lord Acton as the beginning of the medieval age.

It should not be overlooked that the success of the work and the termination of its scope at 1910 have prompted a continuance. Prof. Harold Temperley has for this purpose stepped into the shoes of Acton and Bury. To many of our younger contemporaries all the history which they wish to learn is post-War or even post-Hitler. To this doctrine Prof. Temperley seems to give his adhesion when he says (in his foreword to the first volume of this new series) "that a survey of the origins of the War exceeds all others in importance, for this period weighs upon us with insistence and has become part of the air we breathe. . . . Upon a right appreciation of the nature and objects of the War depends the future of history in this generation".

No doubt it is important; no doubt, also, it will in the competent and impartial hands of Prof. Temperley and his co-adjutors be a popular and useful corrective to the wild and conflicting theories which fill the Press and din our ears from the radio. Yet one cannot help thinking that there is a profound and rather dangerous fallacy concealed in the seductive words of the editor of the next great historical compilation which is to issue from the Cambridge University Press. Is it really true that a knowledge—if we could obtain it—of the origins and issue of the last Great War exceeds in importance all else that history has to tell us? No doubt it now seems so to many people who are trembling at the result of the present international bifurcation and strife of nations. But might it not have seemed equally dangerous and important at many earlier crises in human history had we been there to feel the shock? We know in fact that it did so appear to thoughtful men at the time when the Roman Empire was giving way to the barbarians.

We need some other yardstick to measure the gravity of events; above all, we need a knowledge of and a faith in the permanence and force of other elements in the human and historic story than those which fill by far the larger part of these forty volumes and will apparently be the main, if not the only, topic in the new series which Prof. Temperley is devising. The things he is to tell us are of great moment and should undoubtedly be spread abroad by all responsible and impartial agencies like the Cambridge University Press and every institution where the truths of history are handed on to future generations. But let us think for a few moments of the other side of human activity; that, for example, which is represented by the persistent and almost equally colossal work of George Sarton in *Isis* and many other publications. Here we have the growth of thought and the discovery of the universe which is going on even now at an accelerating pace, though some countries may be able to expel every impartial man who is struggling to add his mite to the treasure. It may be said, "But if the dogs of war are let loose, all this may be devoured and the human race if it survives will have to emerge again from its cave-shelters in a world of desolation". This is a supposition somewhat on a par with the chance of our planet's extinction by collision with another wandering heavenly body.

We can indeed imagine both these catastrophes, but we do not seriously believe in the measurable probability of either. It would probably be admitted that the recent international discord and warlike preparations have not at all diminished the progress of science. In fact, in many ways they have accelerated it; and it is a tenable proposition that the expulsion of so many Jewish and other men of science from their homes in Central Europe will actually give fresh stimulus to their work and the works of others in the countries of their adoption. The totalitarian States, we must hope, will gradually throw off the incubus of the anti-scientific bias which at the moment is hindering research, diminishing the number of disinterested students, besides inflicting incalculable loss and suffering to those who fall under the ban.

The human spirit has, however, in the past always displayed an unconquerable power for re-establishing itself and making fresh advances. This is the lesson which should be aimed at in all great historical compilations such as that which Cambridge has just completed. In this and many other works the reader is overwhelmed by the mass of learning set out before him. The Cambridge forty volumes make a mighty historical encyclopædia which no one would think of tackling from beginning to end, but in which he would find ample and trustworthy information about any particular subject or person in which his interest was already aroused.

Such preliminary interest and a sketch of the whole in the spirit which we have just indicated, are the things most needed, and in supplying them we would put in an earnest plea for pre-eminence in the treatment of the growth of science or, if you will in a more general sense, the continued growth and enrichment of the human spirit. The notorious political events and figures would still be there, but in a much humbler attitude. We need them as landmarks just as it is useful to remember that Newton's greatest discoveries and the completion of "Paradise Lost" took place almost simultaneously in the year of the Great Plague of London. So many of these popular and traditionally remembered events were actually plagues in the body politic. Who would not have avoided the Great War had he the power and foresight in 1914, just as now we are all absorbed in an attempt to avert another war, still more terrible if it occurred? But those things which we would not avert, but welcome and prize for ever as constructive achievements of humanity, should stand in the forefront of the picture. The foundation of mathematics and astronomy by the Greeks, their work in sculpture and architecture, the law-making genius of the Romans, the Madonna of the Middle Ages, the scientific synthesis of the seventeenth century, the mind of Goethe and the poems of Wordsworth, the ameliorative medicine and the widening of the universe in our own days—these are the things on which history should work most zealously, and make them stand out as the landmarks of the history to be taught in the generations to come.

The whole of the matter is too vast for us to comprehend; it is indeed infinite. Some selection and therefore emphasis are imperative. A higher degree of truth, and stronger hope for the future, would be the aim and the natural result of such an effort.

F. S. MARVIN.

Ancient Egypt and Its History

The Making of Egypt

By Sir Flinders Petrie. Pp. xv+188+85 plates. (London: The Sheldon Press; New York: The Macmillan Company, 1939.) 12*s*. 6*d*. net.

SIR FLINDERS PETRIE is the creator of Egyptian archæology and is still at work. The advances made have been so gigantic in the period of a single lifetime that the world is liable to forget how very new the study is. In the book before us the author sums up his views of the various influences, immigrations and infiltrations into Egypt—and they were many. He gives us more than eighty plates, showing hundreds of objects of all sorts. These he considers qualified to support his theses, which are based on his unrivalled knowledge of the archæology. The line drawings especially are of the beauty we have long grown accustomed to associate with his publications.

The various objects are grouped according to the periods of history, so that in looking through them the reader gets an idea of the characteristic products of each age. The scheme of work is ambitious, envisaging, as it does, the whole range of man and his activities from the time the Nile Valley became habitable down to the Ptolemaic period. A bold attempt has been made to compress all this into the aforesaid 82 plates and 161 pages of text. To these are added three appendixes. They are: an arrangement of the Hyksos kings by a classification of their scarabs; a table of Egyptian skull measurements; a table of periods of history. There is also a complete table of references to the original publication of each of the illustrations.

The author directs attention once more to the existence since Early Predynastic days of a signary in the Mediterranean area, and to the fact that about half of these signs have survived as letters in various alphabets; a curious fact which has never been given the consideration due to it. The conclusion concerning Egypt's share in the world's progress is "that Egypt never originated any new civilization, but was a fertile ground for implanting the products of other lands". The reviewer would add, however, that there has been an artistic sense in Egypt, which lies dormant until brought to life by some movement from outside.

This is more than can be said for some neighbouring countries.

The layman will find much profit and pleasure in studying the plates, but to read the text requires more detailed knowledge than he could possess. The attempt to squeeze so much into so small a space entails a style which at times becomes almost telegraphic in its compression. It also necessitates allusions which are sufficient for the Egyptologist, but must be meaningless to the public. Again, it induces a statement as of fact of much that really needs a discussion which would result in a probability, or perhaps only in a possibility. The system of dates used is the author's own, which is much longer than anything accepted by others. In putting Menes to 4326 B.C., Sir Flinders Petrie puts him a thousand years or more earlier than would anyone else, though even this is a thousand years later than he used to date him.

G. A. WAINWRIGHT.

Universities of the British Empire

The Yearbook of the Universities of the Empire, 1939 (Published for the Universities Bureau of the British Empire.) Pp. xlv+1197. (London: G. Bell and Sons, Ltd., 1939.) 15*s*. net.

IN its main outlines the Universities Yearbook retains the shape given to it twenty-five years ago by its original designers. Its principal features are still: a directory of the officers and members of the staff of each university, general information as to origin, organization, equipment, courses of study, etc., and reports of events of outstanding interest which occurred during the past academic year. The reports, by the way, are in some cases excessively meagre, even such an important university as Bombay, for example, reporting nothing more than the total number of full-time students and the number of degrees conferred.

Preceding the sections dealing with the universities of Great Britain and Ireland, of Canada, of Australia, of South Africa and of India, respectively, are introductory chapters treating briefly of their history, regulations and practice. The first of these, which has a rather jejune appearance, concludes with an interesting account of the genesis of a Consultative Committee of Vice-Chancellors and Principals. That some such body should exist to co-ordinate policy in matters of common concern and stimulate adjustments to the changing social environment and national needs is sufficiently obvious. What surprises one is that it did not exist before 1918. The chapter about the universities of Australia has been extensively revised for the present issue of the Yearbook by the Australian Vice-Chancellors' Committee.

In eleven appendixes, covering some two hundred and fifty pages, are assembled an assortment of notes on admission to universities, professional bodies, student organizations and other matters, contributing to make the Yearbook a sort of 'inquire within upon everything' connected with universities. Among them are useful particulars of post-graduate scholarships and grants for advanced study and research and centres of scientific research and information. These reflect the conspicuous defects in the organization of the finance, distribution, direction and co-ordination of scientific research in Great Britain to which Prof. J. D. Bernal has directed attention so forcibly in "The Social Function of Science". Another appendix epitomizes returns (not published elsewhere) from universities and university colleges in Great Britain and Ireland of their students from abroad. The total number, 6,214, includes 1,614 from other countries in Europe, 2,180 from Asia, 1,061 from Africa, 1,034 from America and 325 from Australasia. Of European countries the largest contributors were: Germany (532), Poland (195), Holland (77), Hungary (71), France (65) and Norway (64). Students from India numbered 1,350, from China 233, from Egypt 383, from Palestine 146, from South Africa 532, from the U.S.A. 517, from Canada 271.

The body responsible for the production of the Yearbook is the Universities Bureau of the British Empire. Full particulars of its constitution appear, together with its last annual report, on pages xi-xlv. An important event in the Bureau's history was the secretary's tour of the Canadian universities, which took place in the spring of last year. He visited all of them and discussed with members of their staffs ways and means whereby the Bureau could be of service to them. He returned via the United States, and while there discussed with the presidents of Harvard and Yale, the president of the Carnegie Corporation of New York and the director of the Institute of International Education, the possibility of the visit to England in 1941 of some of the heads of universities in the United States, with a view to their meeting the heads of universities in the British Empire at the congress to be held in Manchester.

Communication:
a Philosophical Study of Language. By Karl Britton. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi+290. (London: Kegan Paul and Co., Ltd., 1939.) 12*s.* 6*d.* net.

LANGUAGE has become again a central point of interest for philosophers, logicians and psychologists. Historically this has always been the case when thinkers begin to question the reality of values and the import of the ultimate principles of explanation of the world. The Greek sophists, the medieval nominalists, Hobbes, the eighteenth century sensualists, and the modern positivists are in the direct lineage of the contemporary analytical philosophers who make of language the leading real problem of knowledge. From this angle, Mr. Britton's book is of particular importance, in so far as it retraces in an orderly fashion the manifold cross-currents which enrich the field of logical controversy.

It begins with a discussion of four principal kinds of language: the language of empirical propositions, necessary principles, moral judgments, and poetry; and it endeavours to show that all these can be explained in terms of the informative and of the emotive function of language. When a language refers to what we may experience, it is informative; otherwise it is emotional. It is easy to confuse informative and emotive uses of words; and the chief object of analysis would be to distinguish these clearly. One of the results of the analysis is to show the place of necessary rules in linguistic behaviour, never to indicate the mutual relevance of psychology and logic. Mr. Britton discusses these problems with competence and skill. He also discusses the views of many recent writers, including Russell, Moore, Wisdom, Empson, Sheffer, Lewis, Wittgenstein and Carnap. Hence the interest of this volume, which may be read as an excellent introduction to the theory and practice of modern logical analysis.

T. G.

The 1938 Mental Measurements Year-book of the School of Education, Rutgers University
Oscar Krisen Buros, Editor. Pp. xv+415. (New Brunswick, N. J.: Rutgers University Press, 1938.) 3 dollars.

THE output of mental tests is now so great that no worker in educational psychology can hope to know more than a small fraction of them. The seriousness of the problem for the conscientious teacher of educational psychology or director of research in that subject is not lightened by the consideration that most of the tests produced are of little or no value, for it has become almost impossibly difficult for him to discover what are the useful new tests and which are worthless.

The fact that this Year-book lists 312 new tests makes it useful to every worker in educational psychology. If it merely did that, it would only be one more of the too numerous psychological publications which preserve equally the valuable and the worthless in psychological production. In fact, it does much more since it contains a critical evaluation of all the tests and the publications on educational psychology which are described. This feature makes it invaluable. It is excellent to see at the end of the description of a test: "these tests serve to increase the number of mediocre tests that are now on the market, without making any scientific contribution to the development of group testing of intelligence". Whether or not this criticism is just in the particular case to which it is applied, it shows the right spirit. Let us hope that this Year-book marks the end of the period of merely listing psychological work without attempting to distinguish the bad from the good.

R. H. T.

The Wild Asses:
a Journey through Persia. By W. V. Emanuel. Pp. 352+12 plates. (London: Jonathan Cape, Ltd., 1939.) 12*s.* 6*d.* net.

HERE Mr. Emanuel records a journey through Persia of a mixed party, described on one occasion by Reuter as of "undergraduates". Though the author repudiates this designation, it does in some degree characterize them and their spirit of adventure. They belonged to the National Union of Students. Their route lay across Europe to Russia, and through the Caucasus into Persia, which they traversed to Meshed; and there they crossed the Afghan frontier for a brief stay at Herat. On their return they crossed the great Salt Desert of Persia, to their edification, if discomfort. Although this record is not intended to be in any sense a scientific study—anything in that nature is precluded by the rapidity with which the party travelled—the author has a keen eye for the distinctive characters of both peoples and places; and the freshness of his point of view and the acuteness of his observation give his book something more than a passing interest. It may be noted that the points which impressed him most in Persia were the sophistication of Persian people and society and the penetration of the Germans everywhere, especially in business, education and military matters.

Quelques Techniques actuelles en physique nucléaire
Méthode de la Trochoïde; Électrons positifs; Spectrographie de Masse; Isotopes; Compteurs de Particules à Amplification linéaire; Compteurs de Geiger et Müller. Par Prof. Jean Thibaud, Louis Carta et Paul Comparat. Pp. vi+276+12 plates. (Paris: Gauthier-Villars, 1938.) 100 francs.

THE greater part of this volume is devoted to a critical study of methods in mass-spectrography, and more particularly of the methods and results of the work of the last four or five years. This section, therefore, forms a valuable and needed supplement to the standard treatise of Aston. The remaining sections deal in considerable detail with the construction and uses of counters and counting circuits. Within these somewhat severely prescribed limits the treatment is remarkably complete, and it is typically French in its lucidity. The book, which is lavishly illustrated, is a notable addition to the literature of the experimental part of nuclear physics.

Elementary Mathematical Statistics

By Prof. William Dowell Baten. Pp. x+338. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 15s. net.

BOOKS concerned with statistics fall roughly into two classes, those which aim at providing a variety of methods for the analysis of data without making any serious attempt to prove the formulæ given, and those which concentrate on the proofs of the propositions under discussion.

Dr. Baten's work falls into the latter class. It will undoubtedly be criticized as too narrow by those who desire a compilation of methods, and such criticism would not be entirely unjust, as exact tests of significance, experimental design and analysis, orthogonality and degrees of freedom are either mentioned very briefly or entirely omitted. The discussion of correlation is very full, but leaves one wondering whether a discussion of regressions would not have been of more value. To the research worker and the student, therefore, the book is not to be recommended for uncritical use. To the teacher, however, it should prove of value, as the approach to many of the questions raised is of attractive simplicity. Where it is necessary to provide algebraic demonstrations to students with limited mathematical knowledge this book should be a useful guide. K. M.

A Guide to Chemical Laboratory Practice:

for Beginners. By Prof. H. Bassett. Pp. viii+94. (London: Macmillan and Co., Ltd., 1938.) 2s. 6d.

IN this book an attempt is made to supply the information which is usually provided by the demonstrators in the elementary laboratory. In this way time and trouble may be saved. Some of the information may seem rather trivial, as when the student is warned not to stumble and fall when carrying a desiccator; but most of the hints given are useful. Every teacher knows that it is of the utmost importance to instil into beginners those habits of neatness and orderly work without which no real progress can be made in practical chemistry, and this modest volume will certainly assist in this way if students can be persuaded to read it and carry out the good advice which will be found in abundance on its pages.

Principles of Electricity and Electromagnetism

By Prof. Gaylord P. Harnwell. (International Series in Physics.) Pp. xiii+619. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 30s.

PROF. HARNWELL'S book is an interesting, and on the whole successful, combination of the classico-theoretical and modern-practical treatments of electromagnetism. We have, for example, in Chapter i the conventional elementary treatment of electrical images, while Chapter v treats at some length of current-voltage relations in non-ohmic circuit elements, including the interesting ceramic material, thyrite. A good deal of space is given to conduction in gases and to thermionic vacuum tubes, and in general any topic taken up is given a space very nicely proportioned to its present-day importance rather than to its historical interest. British students will find the book more suitable for reference than as a regular companion in a degree course—and its strongest appeal will be to the physicist with a marked bias towards the practical side of his subject, or even towards the more academic side of electrotechnics.

Logical Aspects of Educational Measurement

By B. Othanel Smith. Pp. x+182. (New York: Columbia University Press; London: Oxford University Press, 1938.) 12s. 6d. net.

THE author of this book has attempted to clarify his ideas about the meaning of measurement in education, in which he has found most help from the well-known writings of Dr. Norman Campbell. Approximately the first five chapters are devoted to the logical foundations of measurement, the last four to questions more particularly concerned with educational measurement.

The logical treatment is nothing like so rigorous as that found, for example, in the paper by Mr. J. Guild on "Are sensation intensities measurable?", in the current Report of the British Association for the Advancement of Science, but it follows somewhat similar lines. Mr. Othanel Smith concludes that quantitative units have not been established in educational measurement. The requirement of *order* has often been fulfilled, but not that of *addition*. Just now in educational measurement, he thinks, it is more important to concentrate on the operational interpretation of *order* and *equality* than to seek for an additive structure.

Nauka Polska:

jej Potrzeby, Organizacja i Rozwój (Science and Letters in Poland: their Needs, Organization and Progress). Tom 24. Pp. x+587. (Warszawa: Kasy Imienia Mianowskiego, 1939).

UNDER the able editorship of Prof. S. Michalski *Nauka Polska* each year acquaints Polish men of science with the tendencies and general advances over a wide field. In the latest volume there are four articles (three short and one fairly long) entitled respectively, "Science and the Irrational Element", "Humanities and the Vital Needs of the Nation", "Visual Thinking" and "Scientific Life in Modern Cracow". In the second of these, the author, Prof. K. Dobrowolski, discusses the part that each branch of the natural sciences can have in enhancing national and cultural life.

Most of the volume is taken up with numerous shorter items, reviews and a bibliography of the "Science of Science". Some of these shorter notes, such as that describing the foreign literature available for students in Polish libraries, are of direct interest to British readers, and it is perhaps significant that some thirteen English books are among the thirty reviewed in this issue of what may be regarded as a most influential scientific publication in Poland.

Use of Oxygen on the Mount Everest Expedition, 1938

By Peter Lloyd

THERE were two types of oxygen apparatus available to the Mount Everest Expedition of 1938. One was the open type, used by the 1922 and 1924 expeditions, in which the climber breathes a mixture of oxygen and air. The other was a closed circuit apparatus in which pure oxygen is breathed. Now the essence of the oxygen problem is the fact that the apparatus cannot be effectively tested except at very high altitudes. Serious oxygen lack does not make itself felt below about 23,000 ft., so that a test in the Alps is not conclusive even with the closed apparatus, and with the open apparatus it would be useless. Similarly, a test in a pressure chamber is of little value since it cannot include the vitally important acclimatization factor. There was therefore no possibility of making a comparison of the two units in Europe, and it was decided by the leader of the Expedition that both must be taken.

The open apparatus was similar in principle to that devised for the 1922 expedition[1]. The oxygen was contained in two Vibrax steel cylinders of 500 litres capacity at 120 atmospheres pressure, and was fed through an adjustable spring-loaded governing valve to a small canvas bag acting as a reservoir, and thence to the mouthpiece. A pressure gauge was fitted, but no flowmeter, and the governing valve was intended to be set and locked at the required delivery rate. If the lung ventilation of a man doing hard work at 29,000 ft. above sea-level (245 mm. mercury) is taken as 60 litres a minute, then an apparatus of this type delivering oxygen at the rate of 2 litres a minute (as measured at 760 mm. mercury) will raise the partial pressure of oxygen in the inspired air from the original 51 mm. to 71 mm., corresponding to an atmospheric pressure of 341 mm., or an altitude of 20,800 ft. Similarly, a climber at 25,000 ft. (285 mm. mercury) with the same oxygen delivery and lung ventilation will have an oxygen pressure in his inspired air corresponding to that obtained at 17,500 ft. Since at 20,000 ft. an acclimatized man can still move almost as fast as at Alpine altitudes, it is generally assumed that a delivery rate of 2 litres per minute is about right, and at this rating the apparatus with its charge of 1,000 litres would last a little more than eight hours. The total weight was 25 lb., the charged oxygen cylinders accounting for 19 lb.

The closed unit was similar to that taken by the 1936 expedition[2] and was of the type which is used for rescue work in mines. It had been improved as a result of tests carried out by Dr. Warren in 1937, in the course of which he used the apparatus on the Matterhorn and the Wellenkuppe. The oxygen was contained in a single cylinder of 750 litres capacity, and from the cylinder the gas passed through the reducing valves into a low-pressure reservoir. The user drew oxygen from this reservoir through his face mask, covering nose and mouth, and the expired gases passed back into the reservoir through a canister packed with soda lime in which the carbon dioxide was absorbed. There were, in effect, three separate automatic valve systems; the pressure-reducing valve which lowers the pressure to about 2 atmospheres and from which a weep of $\frac{1}{2}$ a litre a minute is fed into the reservoir, the breathing valve which opens when the flexible reservoir begins to collapse under external atmospheric pressure, and the lightly spring-loaded mica valves on the flexible connexions to the face piece, which control the direction of flow through the circuit. All these had to work correctly if the apparatus was to succeed. In addition, there were two hand-operated valves, one the screw-down valve on the main supply and the other a by-pass by means of which the supply of fresh oxygen to the reservoir could be supplemented. As on the open apparatus, a pressure gauge was fitted to indicate the residual pressure in the cylinder.

Every effort was made to lighten the construction, even at some sacrifice of rigidity, but the apparatus weighed 35 lb. for a supply which was calculated to last $5\frac{1}{2}$ hours. This was a weight which a fit man could easily carry over moderately difficult ground, but it might become an impossible burden on steep rocks or if the climber were weakened by lack of food or any other cause. Of the 35 lb. weight, only $14\frac{1}{2}$ lb. was in the charged oxygen cylinder, 10 lb. was in soda lime and the remaining $10\frac{1}{2}$ lb. was in the frame, the canister and the valve gear. But although the quantity of oxygen was small, virtually all of it could be effectively used, while with the open apparatus most of the oxygen would go to waste in the expired air. It was thought that the high oxygen pressure obtained and the greater efficiency of utilization would outweigh the obvious disadvantages.

A preliminary test on the closed apparatus was done on the journey out to Tibet, at Thangu, in Sikkim (12,800 ft.). In the main, the results were

satisfactory, but it was found that in still air the oxygen may get so overheated by the reactions in the soda-lime that conditions become thoroughly unpleasant for the wearer of the apparatus.

The first high-altitude test in the closed apparatus was done by Dr. C. B. Warren on the snow slopes above the North Col (23,000 ft.). He found that, although the unit seemed to be in perfect mechanical order, it tended not to stimulate but rather to suffocate him. He was actually moving more slowly than the other climbers, and was forced to stop after every dozen steps to recover his breath.

When the camp on the North Col was re-occupied about ten days later, this gave me a chance for a comparative trial of the two forms of apparatus between Camps iv and v (23,000–25,700 ft.). The open unit was tried first, and it was found that within half an hour the breathing technique had been mastered and the tricks of the apparatus had been learnt. The oxygen was drawn into the lungs through a rubber mouthpiece which was held between the teeth. The technique consisted in biting the rubber to prevent an outflow of gas when breathing out and releasing it when breathing in. When the flow of oxygen was stopped by biting the mouthpiece, the oxygen accumulated in the small canvas bag mounted above the cylinders.

The apparatus was perfectly comfortable. As to speed, I found that I was moving as fast as the fastest member of the party and therefore much better than without the help of the oxygen. But the main difference was the absence of strain or fatigue. The day before, climbing from about 21,000 ft. to 23,000 ft., I had felt really tired, whereas on this day climbing from 23,000 ft. to 25,700 ft. and down again left me comparatively fresh.

Partly to economize oxygen, and partly to test the effect of suddenly removing its stimulus, I turned off the supply at every halt, but this did not seem to produce any reaction whatever. On the other hand, when the first cylinder was running out and I was climbing with a rapidly decreasing supply, the effect was immediately noticeable. The oxygen flow had been set the previous night to a rate corresponding to 2·2 litres a minute at one atmosphere, and at this setting the first cylinder lasted until ten minutes below Camp v. The oxygen supply was turned off six hundred feet above Camp iv and the descent completed without it.

On the following day I took the better of the two closed units and started off with a Sherpa, intending to climb about 1,500 ft., and to compare my times and sensations with those of the previous day. But it soon became evident that there was something very wrong. Mechanically everything was perfect, and the valves were opening and closing like clockwork, but inside the mask I was nearly suffocating, and I had to stop frequently to take a dose of fresh air. If the whole of the system was filled with fresh oxygen, then for a time conditions were pleasant enough, but very quick deterioration followed. The absorption seemed to be satisfactory, for the soda lime canister was warm—uncomfortably warm in fact—but the effects of the overheating were much more serious this time than they had been under similar conditions at Thangu. The mica valves on the mask were tested and found to be functioning, and the breathing valve controlling the supply to the reservoir was short circuited by opening the by-pass valve, but nothing that I could do improved the results in any way.

The open apparatus was used again on an attempt on the summit involving three days' climbing, the first day up to Camp v, the second up to Camp vi, and the third for the attempt. It worked perfectly for the second ascent to Camp v, and just over one cylinder was used. On the following day we set off over heavily snow-covered rocks for Camp vi, which had been pitched at 27,200 ft. Thanks to the oxygen apparatus, which was working perfectly, I was feeling very fit and reached Camp vi half an hour or an hour ahead of the others who were not using oxygen. The camp was magnificently situated on a gently inclined scree slope, and I was interested to find the scree in several places cemented together with ice, which is not known to have been found before at this height*. Even here I felt absolutely no ill-effect on turning off the oxygen supply when I stopped climbing.

The story of our attempt to reach the main ridge of the mountain on the following day has already been told. We were forced to retreat after advancing only a short distance above the camp. In spite of oxygen, I seemed to feel the early morning cold as much as my companion Tilman, and I made no more impression than he did on the rocks we were trying to climb. On easy ground, however, it increased climbing speed, as was immediately evident when we were roped together.

It is not an easy matter to do scientific work above 23,000 ft., for Everest has a way of sapping one's energy and leaving little inclination for detailed work. As a result, the tests which were done on the oxygen apparatus are neither so complete nor so precise as one would like them to have been, and our conclusions cannot have the force of proofs. The failure of the closed apparatus in two independent tests on the North Col has yet

* In "Everest 1933", p. 346, L. R. Wager reports the greatest height at which ice was found as 25,700 ft. Some névé was seen at about 28,000 ft.

to be satisfactorily explained, but the fact of its failure, coupled with the mechanical troubles which were experienced with it, give powerful backing to the arguments which have already been advanced against it. A closed apparatus was brought back from Everest, and was tested again under actual climbing conditions to ascertain whether there had been any mechanical fault which might have caused the failure. Some repairs were necessary, but the canister was not exchanged, and neither the breathing valve on the flexible reservoir nor the mica valves on the face-piece were touched. The test showed that at these low altitudes (up to 2,000 ft.) the apparatus worked perfectly well.

Perhaps the hardest thing of all is to estimate the advantage conferred by the use of oxygen. Comparison of climbing speeds is difficult and dangerous, but from the trials of 1938, it would seem that from 23,000 ft. to 26,000 ft., the use of oxygen in the open apparatus at 2 litres a minute has only a slight effect on natural climbing speed. The reduction of strain and fatigue, however, provides ample justification for its use at this height. Above 26,000 ft., the increase in climbing speed becomes more and more apparent. The maximum advantage is obtained, as one might expect, on easy ground where the climber moves with steady rhythm. More difficult climbing requiring greater exertion results in an increase in the rate of breathing, and with the open apparatus this implies a fall in the partial pressure of oxygen entering the lungs.

We suffered in 1938 from the necessity of taking two different forms of apparatus each with different sized cylinders, but it is hoped that the results we obtained will enable a future expedition to make a definite choice.

[1] See Prof. G. I. Finch's account in "The Assault on Mount Everest", p. 264; also P. J. H. Unna, "The Oxygen Equipment of the 1922 Everest Expedition", *Alpine J.*, **34**, 235.

[2] See "The Medical and Physiological aspects of the Mount Everest Expeditions", by C. B. Warren, *Geog. J.*, **90** (August 1937).

A Hundred Years of Photography

THE satisfactory recording of a scene by photographic means first became possible in 1839, when Daguerre published details of the process which bears his name. The 'base' consisted of a silver or silvered metal plate iodized on the surface, and the exposure amounted to about ten minutes in bright sunlight. 'Development' took place in mercury vapour, which acted preferentially upon the exposed portions, yielding a direct positive. A serious disadvantage of the process was the fact that only one picture was obtained, and there was no known process of copying originals. Fox-Talbot in 1840 carried the art a stage further by obtaining negatives on paper, using silver iodide as sensitive material, developing in gallic acid, waxing the paper to make it transparent and making prints by exposing in front of a piece of paper sensitized with silver chloride.

The chief drawback at this time was the length of exposure necessary. Scott-Archer in 1851 considerably increased the speed with his wet collodion process. This latter process was the first successful attempt to use a protective colloid for suspending the light-sensitive substance. The wet collodion process was very successful and its chief drawback was the fact that the plate had to be exposed while still wet, thus necessitating the preparation of the plate 'in the field' immediately before exposure.

The next important step was taken in 1871, when Maddox used gelatine instead of collodion as protective colloid and produced the first dry plate. The dry plate was not successful until later, when it was found essential to remove the salts formed by the reaction between silver nitrate and soluble halide. In addition to a gain in speed, the dry plate had an enormous advantage over the wet plate for field work, but the wet plate is still extensively used to-day in the photo-engraving industry.

The spectral sensitivity of the silver halides is confined to the blue and violet end of the visible spectrum, but it was discovered in 1873 that the addition of certain dyes conferred added sensitivity in the direction of increasing wave-length. Since then a systematic search has been made, and is still going on, for other sensitizing dyes giving greater sensitivity and extending the spectral range of the added sensitivity. It is possible to-day to sensitize to all wave-lengths up to about 11,000 A.

Since the discovery of the dry plate, no fundamental changes have taken place in photography. All the advance has been towards improved photographic quality (for example, latitude and gradation, speed, graininess and spectral sensitivity). The inherent sensitivity of the silver halides to ultra-violet, X-rays and γ-rays has found its application in scientific work. Indeed, during the last fifty years, photography has been an invaluable tool in scientific research. One has only to recall the part played by photography in

astronomy and spectroscopy to realize how difficult, and in some cases almost impossible, much of the work would have been without it. On the other hand, the manufacture of photographic emulsions is still largely governed by trial and error, though of course a great deal of knowledge has been gained empirically. The gelatine used is a natural product which contains compounds essential to the production of a satisfactory emulsion, and although something is known of the nature of these compounds their significance is not yet fully understood. Photography has gained much from the advance in organic chemistry, which has paved the way towards the synthesis of sensitizing dyes. Enormous numbers of dyes have been prepared and tested for the sake of a small percentage which have proved useful. The mechanism of dye sensitization is not yet understood, but by a systematic study of the behaviour of dyes sufficient empirical knowledge has been obtained at least to guide the search for new dyes into more fruitful channels.

It is a far cry from the Daguerreotype plate of 1839 requiring 10 minutes' exposure in sunlight to the plate or film of 1939 requiring 0·01 second under similar conditions of lighting and lens aperture, and it appears to-day that the speed cannot be greatly increased while retaining other factors such as grain within reasonable limits. The same could, however, have been said five years ago, yet the speed of the fastest available material has been increased several times since then.

Even a brief review such as this would be incomplete without a word on colour photography. A practical method of additive colour reproduction was conceived so early as 1868, but could not be developed into a practical process until satisfactory panchromatization was achieved. The mosaic screen processes of to-day are the outcome of these early theories and have reached their present stage of perfection largely by the increase in speed and colour-sensitivity of photographic materials in general. Subtractive colour processes have within the last few years received added impetus by the development of colour former and developer coupling methods, as well as improvements in emulsion-making technique. Most of the practical advance in colour photography has taken place during the last thirty years, mainly because improvement was not possible in any colour process until efficient sensitization in the red region of the spectrum had been achieved.

The pioneers of photography were concerned with discovering a process by which the beautiful little pictures shown on the screen of the camera obscura could be permanently recorded, but the art has proved of such important application in the field of scientific research that we may well pause to commemorate the centenary of photography.

The Royal Photographic Society held a series of special centenary lectures during last winter session; celebrations were held in Paris earlier this year, and on May 17 a joint meeting of the Royal Society of Arts and the Royal Photographic Society was held in the lecture hall of the Royal Society of Arts, London. This joint meeting was particularly appropriate, because it was out of the Royal Society of Arts that the Royal Photographic Society, the first photographic society in the world, was formed in 1853. Dr. Olaf Bloch opened the proceedings from the chair and the first speaker was Mr. Peter le Neve Foster, the great-grandson of Peter le Neve Foster who, as a member of the Royal Society of Arts, was partly instrumental in the formation of the Royal Photographic Society. The speaker referred to papers on photographic subjects read before the Society between 1840 and the formation of the Royal Photographic Society.

The next speaker, Miss M. T. Talbot, gave a very interesting sidelight on the character and family life of her grandfather William Henry Fox-Talbot, who may be called the pioneer of photography in Great Britain. He was the originator of the negative-positive process, whereby any number of copies could be obtained from one original.

Mr. Dudley Johnston then spoke on behalf of the Royal Photographic Society and stressed the cordial relations that had always existed between that body and the Royal Society of Arts. He gave an outline of the history of the formation of the Royal Photographic Society, which arose out of the exhibition of photographs held in 1852 under the auspices of the Royal Society of Arts. He read extracts from correspondence between the early organizers who were responsible for the formation of the Royal Photographic Society, from which it appeared that Fox-Talbot generously relinquished his patent rights on the calotype process in favour of the amateur photographer in order to make the formation of a photographic society possible.

Mr. A. J. Bull then gave a demonstration of Fox-Talbot's photogenic paper, and the wet-collodion process originated by Scott-Archer in 1851 and still extensively used in the photo-engraving industry.

A number of exhibits of historic interest were on view. Some early cameras of Fox-Talbot were supplied with a hole and cork in the front, so that the operator could remove the cork and apply his eye to see how the exposure was getting on. Of scientific interest was the result of an attempt by Sir William Crookes to photograph the moon in 1855. In addition, photographs made by the early processes, fine as some of them were, showed the enormous progress that has been made in the last hundred years.

Submicroscopic Morphology of Protoplasm and its Derivatives*

CYTOPLASM

CYTOPLASM is neither a true liquid nor a true solid, but has an interesting combination of characters which place it between the two states. It may contain as much as 97 per cent water, and in some circumstances exhibits streaming, or flow; in contrast, it has some measure of rigidity, tensile strength, and elasticity. It is not perfectly elastic, however, but undergoes plastic deformation; the surface is sticky, and the material may be drawn into fine threads. To these properties must be added thixotropy (a change from the semi-solid to the semi-liquid state caused by stirring), imbibition, semipermeability, and optical anisotropy. Earlier attempts to explain the properties of cytoplasm, for example, the 'alveolar', 'granular', and 'fibrillar' hypotheses, have proved inadequate, and have been discarded in favour of a gel structure: whereas the former postulated structural units of microscopic dimensions, the latter involves a structure beyond microscopic resolution. A colloid is described as having a dispersed phase in a continuous dispersion medium. Ostwald describes nine possible combinations, since either of the two phases may be liquid, solid, or gaseous, and eight of these are recognized in Nature (that is, all except the gas-gas combination). A consideration of the properties of each fails to explain all the properties of cytoplasm, and it would appear that the substance cannot be an ordinary colloid with dispersed particles.

Within limits, the shape of the particles does not affect the properties of a dispersoid, but if they are filamentous, as indeed is known to be the case in cellulose and proteins, they will be in frequent contact with one another, and form a continuous framework, that is, a reticular system instead of a corpuscular one, so that both phases are continuous and mutually interpenetrating. It is essential that the 'framework phase' be solid, though the second phase may be either solid, liquid, or gaseous. In order to follow so far as possible the terminology of Nägeli, who laid the foundations on which the present conceptions have been built, the framework phase is called the 'micellar framework', and the meshes of the network the 'intermicellar spaces'. The material occupying these spaces is called the 'imbibition medium', as distinct from the dispersion medium of ordinary colloids. Whereas reduction in size of the particles of a corpuscular dispersoid would, when molecular dimensions were reached, result in a true solution which would not have colloidal properties, a similar reduction in the dimensions of a micellar framework would simply mean a decrease in thickness of the micellar threads, leading ultimately to a molecular reticulum which would retain many of the properties of a colloid, and if the points of attachment were sufficiently numerous would still be a gel. It may now be considered how the known constituents of cytoplasm can be fitted into such a plan.

In addition to water and inorganic constituents, the cytoplasm consists of proteins, phosphatides, and lipoids. The fats, which may be taken as representative of the last group, are formed from fatty acids esterified with glycerol. The molecule may be pictured as a three-pronged fork (Fig. 1*a*), the prongs representing lipophilic, fatty acid chains. They have neither hydroxyl nor carboxyl groups, and, in consequence, are immiscible with water. The phosphatides, by way of contrast, are of a polar character. For example, lecithin is a glycerol ester with two fatty acid chains and one hydrophilic choline phosphate group. As the hydrophilic and lipophilic groups are mutually repellent, the molecule may be compared with a tuning fork having two lipophilic prongs and a hydrophilic handle (Fig. 1*b*). The proteins are polypeptide chains of indeterminate length with various side chains, which may be hydrophilic, lipophilic, acidic, or basic, according to the protein. These chains have three important characteristics:

(*a*) A repetition of similar links, comparable with the metameric segmentation in zoology; (*b*) a great variety of composition due to differences in possible arrangement of the side chains; and (*c*) a reversible contractibility which is probably important in vital processes.

Of the three constituents mentioned, the protein chains alone have a structure capable of forming a molecular reticulum. Moreover, this framework is capable of carrying the other constituents of the cytoplasm in association with suitable side chains. Indications of possible

* Prof. A. Frey-Wyssling, professor of botany in the Swiss Federal Institute of Technology, Zürich, delivered a series of three lectures at University College, London, on March 6, 7 and 9. The contents of the first two, dealing respectively with the submicroscopic structure of cytoplasm and chloroplasts, are summarized in this article; the principal contents of the third lecture, which treated the submicroscopic structure of cell walls, are covered by the article which appeared in NATURE, 143, 899–904 (1939); the lecture is to be published by Prof. Frey-Wyssling in the October (1939) number of *Science Progress*. Details of the subject, with an extensive bibliography, are given in Prof. Frey-Wyssling's book, "Submikroskopische Morphologie des Protoplasmas und seiner Derivate" (Berlin: Gebrüder Borntraeger, 1938).

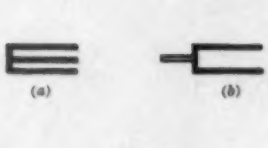


Fig. 1.

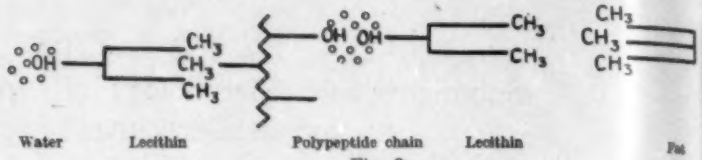


Fig. 2.

combinations of this type are suggested in Fig. 2. Fig. 3 indicates types of union such as might occur at points of attachment of the chains themselves. Type I, between two lipophilic groups (|—CH_3 H_3C—|) is a homopolar cohesion bond of the kind found in paraffin wax; it would be affected by changes in temperature. Type II, between hydrophilic side chains (|—OH . . . HO—|) represents a heteropolar cohesion bond, or secondary valency bond; it may be loosened by heteropolar agents, and is capable of swelling. Type III, between acidic and basic side chains (|—COO^- . . . NH_3^+—|) forming a salt by ionic valency bonds, is affected by changes in hydrogen ion concentration. Type IV is a primary valency bond, and this particular type is dependent on redox reactions. A loose reticulum of the kind illustrated in Fig. 4, held by such bonds, would be sensitive to many kinds of change in environmental conditions.

The property of semipermeability may be controlled by lipoids incorporated in the protein network. These must be accumulated in the peripheral zone, because dyes which cannot penetrate the plasmatic surface spread freely in the cytoplasm when introduced by micro-injection. The high water content of cytoplasm together with mechanical rigidity, elasticity, and tendency to retain shape, are readily explained on the basis of a reticular framework, but would be difficult to account for on other systems. The properties of plasticity, viscosity, and protoplasmic streaming are less easily explained. It may be assumed that under certain conditions some of the bonds are loosened for a short time so that the micellar threads may slide over one another, and find new points of attachment. Not all the bonds would be loosened at the same time, for the polypeptide chains move in parallel groups as shown by the optical anisotropy, and this arrangement is responsible for the stickiness, tensile strength, and the possibility of being drawn into threads. Finally, Seifriz has shown that protoplasmic movement has a pulsating rhythm, and it is suggested that this is associated with the periodic contractions of the polypeptide chains.

CHLOROPLASTS

Following the lines which appear to have been so successful in the investigation of cytoplasm, the molecular constitution of the main constituents of the chloroplasts was studied. Approximately half the chloroplast consists of protein, rather more than one third of lipoids, and about eight per cent of inorganic substances. The pigments (chlorophyll *a* and *b*, xanthophyll and carotin) constitute only a very small proportion (for example, 1·5 per cent in tobacco leaves). It would appear probable that the proteins form a micellar reticulum as in the cytoplasm, and that the smaller molecules of the lipoids are lodged within the reticulum. The pigments are probably associated with the lipoids. The chlorophyll molecule may be likened to a signet, or rubber stamp, the disk representing a

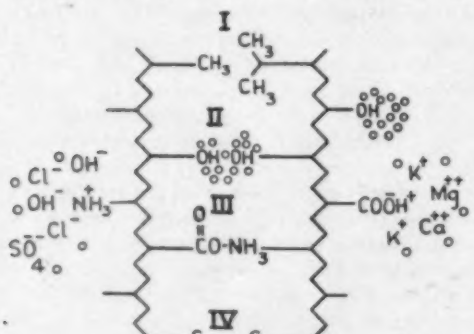


Fig. 3.

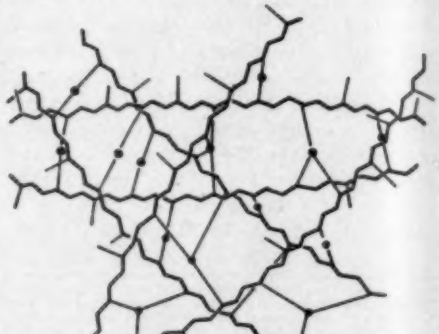


Fig. 4.

so-called porphine ring, which is hydrophilic, and contains the nitrogen and magnesium of the chlorophyll, and the handle representing a lipophilic chain (Fig. 5*a*). The carotinoids are hydrocarbons ($C_{40}H_{56}$), and are completely lipophilic. The xanthophylls are alcohols with one or more OH groups, and their affinity for water varies accordingly. Fig. 5*b* is a diagrammatic representation of the molecule.

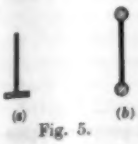


Fig. 5.

Some indications of the probable arrangement of these units within the chloroplast are afforded by the optical properties. From observation of double refraction, and of the changes of this property with change in the imbibition medium, it is inferred that the chloroplast is composed of submicroscopic layers, and that

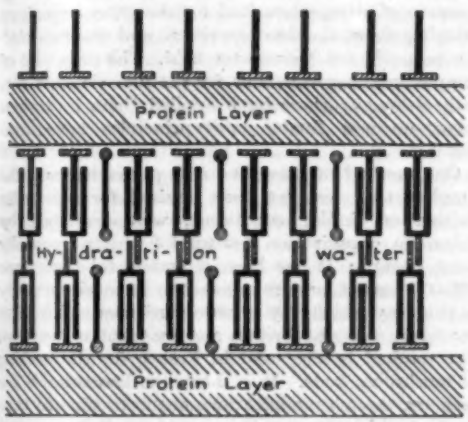


Fig. 6.

one type of layer consists of regularly orientated lipoid molecules. Since about half the chloroplast is protein, perhaps this alternates with the lipoid layers. Menke has actually observed a microscopic layering in some instances, and it would therefore appear likely that this suggestion is correct. Chlorophyll exhibits fluorescence when dissolved in alcohol or acetone, but the property is lost when water is added, because the molecules tend to form aggregates in which the lipophilic portions are directed towards one another and away from the water. Chlorophyll also exhibits fluorescence in the living chloroplast, and when in the form of mono-molecular layers on aluminium hydroxide, or with layers of lecithin. It is concluded that in the chloroplast chlorophyll occurs in layers, and, as already mentioned, in association with the lipoids.

Studies of the absorption of light by chlorophyll in the living chloroplast and various solvents, however, indicate that in the chloroplast it must occur in contact with an aqueous phase. Fig. 6 shows a possible arrangement of the units involved which satisfies all the requirements mentioned, including the association of the chlorophyll with the lipoids as required for fluorescence, and with an aqueous phase as required for light absorption. Moreover, the scheme is quite compatible with the findings of plant physiologists. Although some assert that the chlorophyll is concerned in the reduction of the carbon dioxide molecule, there is much evidence that its function is the capturing of energy from light. There is no stoichiometric relation between the carbon dioxide assimilated and the chlorophyll present, but for the assimilation of one molecule of carbon dioxide some 2,000 molecules of chlorophyll are involved. This number is called the assimilation unit, and it is estimated that even if the suggested layered system is complete within grana of about 0·5μ diameter, every chlorophyll layer might well contain about a hundred assimilation units.

Prof. Baur, of Zurich, has obtained traces of formaldehyde photolytically from carbon dioxide esterified with higher alcohols when brought together with a fluorescent pigment and a redox system. The method has striking parallels with the scheme outlined in Fig. 6. Molecular layers of chlorophyll mixed with cetyl alcohol in molecular proportions of about 1 : 30 were fixed by adsorption on threads of cellulose acetate. This system was dipped in a solution of methylene blue buffered with calcium carbonate, which acted as a redox medium (similar to the small amounts of ascorbic acid or iron compounds in the living chloroplast) in an atmosphere of carbon dioxide. In this system the chlorophyll appears simply to capture light, and may be replaced by other fluorescent dyes. It is important to notice also that the chemical reactions occur in a lipoid medium, as, for example, cetyl alcohol. Although Baur's system has an efficiency greatly removed from that of the chloroplast, it offers valuable contributions to fundamental knowledge.

General Conclusions

Evidence from chemistry, physics, and botany, indicates that many important constituents of plants are built of 'mixed systems'. The loose reticulum of the cytoplasm is as yet not well understood, but more is known of the cell wall with its 'rodlet mixed system', and the chloroplast with its layered, or 'platelet mixed system'. Such systems are not uncommon in other biological fields. Rodlet structure is found in the framework of chitin, silk fibroin, keratin, collagen tendons,

muscle myosin, etc., and a stratified structure with alternating lipoid and protein layers in the sheaths of myelinated nerves, the rod-shaped cells of the retina, and the red blood corpuscles. It is interesting, moreover, to trace a 'linear principle' through chain-molecules, micelles, and fibrils, to fibres in the mechanical tissues, and a 'foliar principle' through molecular layers of pigments associated with layers of lipoids and proteins, in discoid grana in disk-shaped plastids which are exposed to light in a flattened leaf. The study of morphology must be pursued not simply to the somewhat arbitrary limit of microscopic resolution, but to the molecule, in which any change results in a change in the nature of the material itself.

S. H. CLARKE.

Obituary Notices

Mr. E. H. Richards

IT is with deep regret that we record the death of Eric Hannaford Richards, of the Rothamsted Experimental Station, Herts, which occurred at Bovey Tracey on May 16.

Richards was born on June 28, 1878, at Hanwell, Middlesex, only son of Joseph Peek Richards, medical superintendent of the Middlesex County Asylum in 1867–92, and educated privately. In 1902 he joined the staff of the Royal Commission on Sewage Disposal, working under Dr. George McGowan, and was put in charge of the Commission's large-scale experiments at Dorking on different methods of sewage purification. These were brought to a successful conclusion. In 1909 he was transferred to Belfast to study methods of dealing with the excessive growth of seaweed in Belfast Lough: this was done in association with Prof. Letts of Queen's University. He then returned to Dr. McGowan's laboratory at Ealing, where he remained until 1913.

In that year, the Hon. Rupert Guinness (now Lord Iveagh) decided to arrange for investigations into the possibility of utilizing organic waste materials as fertilizers. His experience of the Bagshot sands at Woking had impressed upon him the need for making greater use of organic manure, while the growing tendency to substitute motors for horses was decreasing the supply of the stable manure which had hitherto been the mainstay of market gardeners, potato growers and dairy farmers around London. He saw, therefore, the need for opening up new supplies, and he provided the funds for the Rothamsted Experimental Station to carry out a full investigation. E. H. Richards was chosen for this work, and he fully justified the selection.

For the first few years, in collaboration with me, Richards studied the changes taking place in the making and storing of farmyard manure and showed how the losses occurred, and how also they might be reduced. Information was also obtained about the decomposition processes that occurred during the making and storing of the manure. This side of the work was greatly developed by an investigation made in association with H. B. Hutchinson on the factors determining the rate and extent of the microbiological decomposition of straw. The essential conditions were an adequate supply of nutrients, particularly of nitrogen, which was generally deficient in the straw itself; not too acid a reaction; and proper supplies of moisture and of air. The important practical result emerged that straw and other vegetable matter could be fairly rapidly decomposed with production of a humus manure by the simple expedient of adding a source of nitrogenous food for the micro-organisms bringing about the decomposition, and ensuring that the heap did not become too acid. The principles of compost-making were thus for the first time set out, and, although others have applied them in various ways, no new fundamental principles have been found.

One method of using the new principles, and the simplest that has yet been devised for use under British or similar conditions, was developed by Adco, an organization set up for this purpose by Lord Iveagh; it has been so successful that some 100,000 tons of manure are said to be made annually in this way, chiefly by private gardeners and market gardeners in Great Britain and by planters overseas. The method is also used in France for the making of mushroom beds. It is, however, less suitable for farmers, though modifications are from time to time devised which cheapen it.

In recent years Richards was also engaged on an investigation into the purification of effluents from sugar beet factories and milk factories. This was carried out for the Department of Scientific and Industrial Research in association with D. Ward Cutler and his colleagues in the Microbiological Department at Rothamsted, and with S. H. Jenkins, who supervised the large-scale experiments, while Richards himself had as collaborator N. W. Barritt. This work led to the discovery of the conditions necessary for decomposition and purification of the effluents, and methods were then devised whereby these conditions could be secured in factory practice. The whole investigation affords an excellent example of successful collaboration of three groups of workers for the solution of a difficult technical problem.

All his life Richards had suffered from a deformity which might have crushed the spirit of a less courageous man. But his spirit was indomitable, and he let nothing stand in the way of the work he had set himself to do. He had perforce to renounce some of the pleasures of life, but he had the satisfaction of gaining in the highest degree the respect and affection of all who were associated with him. He was a loyal

colleague and a considerate supervisor, but as he was unsparing of himself so he expected and obtained the best that his associates could contribute to the work they had in hand. E. J. RUSSELL.

Rev. W. J. O'Leary, S.J.

FATHER W. O'LEARY, S.J., whose death occurred recently, was born in Dublin in 1869, son of Dr. W. O'Leary, M.P., a well-known Home Ruler. After the usual course of study—in Louvain and Dublin—he was occupied chiefly in teaching physics and astronomy in one or other of the Jesuit colleges in Ireland.

Father O'Leary's work on pendulums aroused his interest in seismology, as the result of a visit to Prof. J. Milne's observatory at Shide, I.O.W. He designed a form of inverted pendulum seismometer in which he replaced the suspension suggested by Tchebicheff by one designed by himself. The shaft of the pendulum was supported on a steel plate which was suspended in a concrete pit by three steel wires. The pendulum thus suspended was extremely sensitive and almost unstable. A suitable arrangement of levers and pens traced a record on smooth paper moving on a rotating cylinder. The weight of the 'bob' was one and a half tons. This instrument gives a very wide and clear record. In connexion with this he designed a recording clock on the free pendulum principle. It is of interest that Father O'Leary made and mounted every part of both seismograph and clock himself—with the exception of the castings for the bob. The instrument constructed by him in 1916 is still functioning in the Rathfarnham Castle observatory, and the steel wires have not been replaced. It is the only one of its kind in existence.

On the death of Father Pigot, director of the Riverview College Observatory at Sydney, Father O'Leary was appointed to succeed him in 1929. Until last year he held this post, when he retired, but still continued his work. In addition to his seismological activities, he did valuable work on the observation of variable stars, and designed a special form of blink comparator for this purpose. His work also included observations on solar radiation.

With the exception of a text-book on mechanics and the results of his observations, Father O'Leary published very little. The detailed description of his free pendulum clock, a piece of original and first-class work, awaits publication. It has only been described in the patent specification.

Father O'Leary was a past president of the New South Wales branch of the British Astronomical Association. He was well known to members of the British Association, before whom he preached on more than one occasion. The end came with great suddenness. For some time his heart had been giving him trouble, but this did not interfere with his work, and only the night before he had been working as usual in the observatory. A most kindly and popular man, he will be missed not only as a scientific worker, but still more as a friend. H. V. GILL.

Sir George Kenrick

BY the death on May 28 of Sir George Kenrick, the educational world has lost a man whose record for public service is remarkable even in a city, Birmingham, which is outstanding in its reputation for the production of leaders in civic work.

Sir George was born in 1850, and after a training as an engineer in the Nettlefold works, he entered the well-known firm of hollow-ware manufacturers founded by his grandfather. At thirty years of age he was elected a member of the Birmingham School Board. He was elected to the City Council in 1903 and was made chairman of the Education Committee, a post which he held for eighteen years. Together with George Dixon, he founded the Birmingham Day Training College for Teachers, giving £5,000 for its endowment. In 1886, as a member of the Council of the Birmingham and Midland Institute, he gave £1,000 towards the equipment of its metallurgical department. When Mr. Joseph Chamberlain announced his scheme for the creation of a University of Birmingham Kenrick subscribed £10,000. He went, with the late Profs. Poynting and Burstall, on a tour of inspection of American universities to acquire first-hand knowledge of the development of engineering departments in the United States with a view to the creation of such a department in the new university. He became chairman of the Building Committee which was responsible for the buildings on the new site at Edgbaston. When the formal opening of the new buildings by King Edward VII was arranged for 1909, it was fitting that George Kenrick should be Lord Mayor, and his services to education were recognized by the King in the conferment of a knighthood. When Mr. Joseph Chamberlain made a second appeal for funds for the University, Sir George again made a donation of £10,000, and in 1914 on the death of Prof. J. H. Poynting he gave £18,000 to endow the Poynting chair of physics.

So far back as 1881, George Kenrick introduced compulsory physical training into the elementary schools of Birmingham—the first attempt made by any school board to introduce physical training as part of the curriculum. Nor did his interest end with the training of the children, for he founded and endowed the Birmingham Athletic Institute for young men and women. He himself was a devotee of outdoor sport—fishing and shooting, cricket, lawn tennis, cycling and walking (even in old age he scorned an overcoat). He was an enthusiastic gardener; and, as a keen entomologist, he had made a fine collection of Lepidoptera in his extensive travels in India and the Americas. He had literary leanings, was specially interested in Shakespeare, and had a fine library.

In disposition, though modest and retiring, Sir George was characterized by quickness of judgment, untiring energy and tenacity of purpose. The city of Birmingham recognized its indebtedness and admiration for his services by conferring on him the highest honour at its disposal, that of an honorary freeman, in 1923. He was unmarried.

G. A. S.

News and Views

Sir Thomas Holland, K.C.S.I., F.R.S.

THE Albert Medal of the Royal Society of Arts for 1939 has been awarded to Sir Thomas H. Holland, "for his services to the mineral industries". Sir Thomas Holland is principal and vice-chancellor of the University of Edinburgh, and in the course of a long and distinguished career has rendered eminent services to industry and industrial research, both at home and in the Empire. Outstanding among the results of his overseas activities is his close connexion with the development of Indian industry, which to-day is based upon the recommendations of the Indian Industrial Commission over which he presided in 1916. He has held many high appointments in institutions connected with science, geology, mining, metallurgy and petroleum, and was chairman of the Council of the Royal Society of Arts during 1925–27. The Albert Medal was instituted in 1862 as a memorial of H.R.H. the Prince Consort, for eighteen years president of the Society, and is awarded annually for "distinguished merit in promoting Arts, Manufactures or Commerce".

Use of Oxygen in Climbing

PROF. YANDELL HENDERSON'S article on "The Last 1,000 ft. on Everest", published in NATURE of June 3, p. 921, gives expression to the physiologist's doubts about the possibility of climbing to 29,000 ft. without the use of oxygen. Prof. Henderson attempts the difficult task of analysing the fall in climbing speed with increase in altitude and suggests that it reaches zero at 29,000 ft. If this conclusion is correct, it is folly to attempt the ascent of Mount Everest without oxygen, but mountaineers may answer that information about climbing speeds at great altitudes is too scanty to justify any precise estimate of limiting altitudes and may point out that, so far, climbers have done as well without oxygen as with it. The most compelling argument in favour of the use of oxygen would be the production of a really effective apparatus. On this point Prof. Henderson is emphatic that the so-called open apparatus is valueless and that a closed unit, involving absorption of carbon dioxide, is essential. But in spite of the possible theoretical advantage of the latter type, it has never been successfully used for climbing at high altitudes. The open apparatus, however, as is pointed out in an article on p. 961 of this issue, by a member of last year's Everest expedition, has twice been used with some success. For the future, it is clear that there is ample room for improvement in methods of oxygen administration in climbing. Increase in efficiency of utilization is desirable provided that it does not sacrifice other essential qualities, but another and perhaps easier line of attack is the reduction of weight by mechanical improvement of valves and cylinders.

Scientific Psychology in France

THE centenary of the birth of Théodule Ribot, and the jubilee of the foundation of the chair of experimental psychology in the Collège de France, of the Laboratory of physiological psychology at the Sorbonne, and of the famous thesis, "L'Automatisme psychologique", submitted by Pierre Janet, will be celebrated by a gathering at the Sorbonne on June 22, under the presidency of the Minister of National Education. Among those who will take part will be E. Faral, head of the Collège de France, Prof. P. Janet, and Prof. H. Piéron, who succeeded Binet as director of the laboratory at the Sorbonne. A jubilee volume, in which many psychologists are collaborating, is to be published in honour of Ribot, Binet and Janet, who were the pioneers of scientific psychology in France in its chief lines of advance, namely, physiological psychology and laboratory investigations, the study of the child, pathological psychology and the study of mental anomalies. The general principle of the comparative method affirmed by Ribot has dominated the development of scientific psychology in France, and has contributed notably to the application to teaching and to industry of the science of the mind. The secretary of the committee responsible for the commemoration is Prof. H. Piéron, Collège de France, Paris.

Philosophical Approach to Religion

THE sixteenth Unity School was held at Jordans Hostel in Bucks on May 12–15. The general subject was "The Philosophical Approach to Religion", and an address introducing the subject was given by Mr. F. S. Marvin on the evening of May 12, when he reaffirmed his belief in positivism, possibly modified in certain aspects to relate it to certain more recent ideas. In the discussion, Lord Samuel put forward a view involving in one aspect the idea of causality leading to a creator God. On May 13, Dr. Helen Wodehouse, Mistress of Girton, in an address characterized by beauty of expression, introduced the question of what is the philosophical approach to religion. The discussion was opened by Prof. J. H. Muirhead, and the Rev. J. H. Brittain contributed some remarks on the historical element in current religion. Prof. John MacMurray gave a stimulating discourse in opening a session on "Religion as the Basis of Reality" and sought to find the essence of religion in personal relationship. He also made some comments on the differences between the scientific and the religious attitudes; discussion of this subject was continued on May 14, when Dr. C. H. Desch spoke on the effect of the development of science on religion. In a concluding address on the future prospects of religion, Prof. Harvey considered a number of factors that have to be taken into account, and put forward some tentative conclusions. Though

the discussions sometimes seemed to show difference rather than unity of opinion, at the last meeting it was felt that there was common agreement in rejecting the objects of devotion put forward by the military States and in seeking to unite men to serve some worthier purpose, which has been known by various names. Valuable interludes were provided by Dr. R. N. Salaman, who spoke on the Society for the Protection of Science and Learning, and by Mrs. Beer, who described a recent visit to Germany and Austria. Further information on the Unity Schools can be obtained from Mr. F. S. Marvin, Pantiles, Cowdale, Welwyn Garden City, Herts.

Experimental Work on A.R.P.

DR. R. E. STRADLING, chief adviser for research and experiment, A.R.P. Department, Home Office, delivered the first of three lectures arranged by the Institution of Civil Engineers on air raid precautions. After referring to the creation some months ago of the special Research Branch of the A.R.P. Department of the Home Office, and to the recent appointment of a Civil Defence Research Committee under the chairmanship of Dr. E. V. Appleton, which would ensure that the full resources of the scientific world would be enlisted in the services of that section of Government activity, Dr. Stradling dealt with the question of protection from the effects of the high-explosive bomb. On detonation, a very high pressure is produced which causes the metal case to expand to possibly one and a half times its original size and then burst into fragments. In addition to the formation of splinters, the expanding gases have two effects: actual movement of gas giving the effect of a very 'high wind', and a wave sent out through the air which is similar to a sound wave. The first effect causes major destruction on a surprisingly local scale; about 30 feet from a large bomb, the effect has practically disappeared. Outside that zone the acoustic type of wave can spread a very long distance. Its effects on a structure can be disastrous, but more especially on those portions which have a high natural frequency, such as windows and the like. Experiments show that the effect is dependent upon the structure itself, as well as upon the form of the wave. Due to the adoption of basements as shelters, the question of earth movements around an exploding bomb is also of importance. There is a zone around the bomb in which few normal structures can be expected to stand, but it is very limited in extent. The wave which is effective at longer distances is somewhat similar to a very slight earthquake and has little effect upon a normal building. Further lectures in the series will be given by Colonel F. J. Wyatt, on camouflage, on June 12; by D. Anderson, on the design of bomb-proof shelters, on June 20; and by Brigadier C. A. Bird, on the work of the military engineer in war, on June 27.

Roman Frontiers in the East

SIR AUREL STEIN has recently completed a survey of the boundary line of the ancient frontier of the Roman Empire in Iraq and Transjordania. This is a part of a projected survey of the eastern frontier of the Empire, of which the Syrian section, with which Sir Aurel Stein's work connects, has been surveyed by Father Poidebard. Sir Aurel Stein's expedition was supported by the British Academy and the Society of Antiquaries of London and carried out with the co-operation of the Royal Air Force and the Iraq Petroleum Company. In a summary account of the survey (*The Times*, June 1) Sir Aurel states that he traced the line of forts along the south and north sides of the Jebel Sinjar. Between Nisibin and Mosul he found the old defences, which had commanded the road of invasion between Mesopotamia and northern Syria. Turning thence to Kirkuk, he visited and determined to his satisfaction the exact site of the battle of Arbela in Alexander's campaign, and along the middle Euphrates had made the remarkable discovery of a comparatively well-preserved castle, which was clearly Roman, and had at its side a barrage, which bore the stamp of Roman work. This affords evidence of the protection given to the trade route so far down as central Mesopotamia, possibly in the reign of Septimius Severus. The Roman track was traceable from the air and in places even on the ground. The last month of survey work covered the Via Nova, constructed in the reign of Trajan from the port of Aqaba on the Red Sea to Petra and the great centres of Syria. This route has now been determined and mapped for a distance of about 120 miles. Several old Roman milestones, from which the inscriptions had almost disappeared, were found in the Wadi Yitm. The distances between the milestones is remarkably accurate. Thence the road climbs to the top of the chain of mountains above the rift valley of the Wadi-el-Arabah, south of the Dead Sea, and follows the line of cleavage to Petra.

Finds from British Bronze Age Barrows

FINDS from the recent excavation of two bronze age round barrows, one at Stockbridge Down, Hampshire, and one at Reffley Wood, King's Lynn, Norfolk, are now on exhibition in the Prehistoric Saloon of the British Museum (Bloomsbury). Both barrows belong to the Early Bronze Age and date from about 1700 B.C. The Hampshire barrow was excavated by Dr. N. Gray Hill, and that at Reffley Wood by Mr. P. L. K. Schwabe and Mr. I. J. Thatcher. While the sites exemplify the two types of ground on which such barrows are found, namely, chalk down and sandy heath, in their characteristics they exhibit a striking similarity. In each the body had been laid approximately in the centre in the contracted position and accompanied by earthenware beakers. At Stockbridge the skeleton was in a remarkably good state of preservation and was accompanied by an almost intact beaker, but at Reffley Wood the skeleton had disappeared and no complete beaker was found, although the whole area under the mound was strewn with fragments. At both sites there were secondary interments in the mound, belonging to the later period of the Middle Bronze Age about 1400 B.C., when cremation was

practised. In both barrows examples of the small segmented Egyptian faience beads were associated with the secondary burials. About eighty finds of Egyptian beads have now been made in Britain. The segmented type occurs in Egypt in the Eighteenth Dynasty from about 1600 B.C. onward, and is especially abundant at Tell el-Amarna (1380–50 B.C.). These beads have also been found in Hungary, Moravia, and Holland, and are thought to have reached Britain through Greece, travelling across Europe along the amber trade-route.

Journal of Endocrinology

A NEW journal, to be devoted to endocrinological subjects, under the title *Journal of Endocrinology*, has recently been founded. Its scope will be the publication of communications which advance knowledge concerning the internally secreting glands, the mode of their actions, the nature of their secretions, and the disorders of their functions. It is hoped that strong support will be given by contributors from abroad. There may be some who question the desirability of any step which might seem to accentuate the division of the field of medical and biological sciences into specialized departments and groups, but there can be little doubt as to the necessity for this new journal. The large and rapidly increasing amount of work on endocrinology published by British investigators, and the lack, hitherto, of a British journal specifically devoted to this subject, has led to the overcrowding of journals having other and more general interests. As a result, there has been increasing difficulty for endocrinologists who have work to publish, as well as for those who need ready access to the published work in this field. The foundation of this new journal was preceded by consultation with the editorial boards of a large number of journals, and it is significant that, without exception, these boards were in favour of the project. The control of the journal is vested in a Council of Management, and it will be edited by Prof. E. C. Dodds, who will be assisted by an editorial board consisting of Dr. P. M. F. Bishop, Prof. C. R. Harington, Prof. G. F. Marrian, Dr. A. S. Parkes, Dr. F. G. Young, and Dr. S. Zuckerman. Dr. R. L. Noble has been appointed as assistant editor. The journal will be published, in the first place, four times a year, and the subscription is 30*s.* or six dollars. The first number is due to appear during this month.

Society of Rheology

THE Society of Rheology was founded in 1929 to further the study of the deformation and flow of matter in the broadest sense. The tenth annual meeting was held at the end of last year. At the banquet it was pointed out that expenses were not being met, and a discussion took place on the status of the Society and its publications programme. The policy favoured, almost unanimously, was to continue publication of the *Rheology Leaflet* and to enlarge it to include invitation review papers, while ordinary research papers would be published, as at present, in the *Journal of Applied Physics*. It was agreed that abstracts and bibliographies should be limited to those covering specific topics (not specified in the report) and that no attempt should be made at any complete covering of rheological literature. The co-operation of members was sought for increasing membership, but it was not mentioned how far this drive was to be international. The obvious method of circularizing authors of papers on rheological subjects, which does not seem to have been carried out in the past, was not mentioned. Rheology is one of those fields which include several sciences—physics, chemistry and physical chemistry and, of late years, biology. Its importance and scope are only now beginning to be generally recognized. Given the necessary increase of support, the Society should then fulfil a very useful function. It would be especially valuable if its finances reached the point where it became possible to list (without full abstracting) all papers bearing on the subject. Now the Society is staking its reserves on the drive for increased membership in such manner that they will be exhausted in two years if the drive fails. It is to be hoped that the Society will receive the required support. Those interested should apply to the American Institute of Physics, 175 Fifth Avenue, New York. The subscription for associate members, who will receive the *Rheology Leaflet*, is 2.50 dollars.

University of Minnesota Hydraulic Laboratory

IN *Engineering* of May 26 is an illustrated article on the large hydraulic laboratory recently completed on the Mississippi River at St. Anthony Falls, Minneapolis, for the University of Minnesota. The laboratory is on Hennepin Island, which is joined to the banks of the river by a dam constructed for the purpose of power development at the falls, and it is designed to operate practically entirely by water diverted above the falls. There is a natural drop of fifty feet and the laboratory can handle for experimental purposes rates of flow in excess of 300 cusecs. Flows up to this amount can be accurately measured by volumetric basins. The laboratory consists of five units, namely, the main experimental laboratory, the hydraulic machinery and pump laboratory, the turbine testing laboratory, the large-scale volumetric tanks, and the lecture room and administration rooms. In the first of these units is a river model section where at present there is under construction a working model, 160 ft. long and 36 ft. wide, of the Mississippi in the vicinity of St. Anthony Falls. The lecture room has been arranged so that large quantities of water can be handled readily at the platform. Below the platform runs the main overhead supply flume of the laboratory, while above it is a head control room containing a constant-level reservoir situated in the tower above the auditorium. The experimental flume which runs through the main laboratory can be used for experiments with ship models.

Improvements in Submarine Telephony in 1938

IN the Engineering Supplement to the *Siemens' Magazine* of May, an account is given of three submarine cables laid last year to the order of the

British Post Office and manufactured by Submarine Cables, Ltd. The first is an additional cable between Nevin (North Wales) and Howth (Eire). The second connects Dartmouth (Devonshire) and Guernsey and the third is laid between Guernsey and Jersey. The cables are of the concentric type insulated by paragutta and, with the exception of the sheathing, which is made suitable to the conditions prevailing round the British Isles, are similar to the cable laid three years ago from Australia across the Bass Strait. The *C.S. Faraday* left Greenwich in July 1938 carrying the Anglo–Eire and the two Channel Islands cables, weighing in all 1,440 tons. When the cable had been laid for ten miles from Nevin, a dense fog came on which completely obscured the buoys marking the course, but nevertheless the ship proceeded on its course and luckily sighted a marked buoy when the fog cleared. The submarine cables are operated by two carrier frequency systems the terminals of which are at Dublin and Nevin, with intermediate repeaters at Howth. The two concentric cables carry eighteen telegraph and fifteen telephone circuits. The laying of the Channel Islands cables presented little difficulty. A single core cable, which had formerly been part of an Atlantic telegraph cable, was relaid in 1914 between Compass Cove, near Dartmouth and Plemont, Jersey. In 1931 this was diverted into Saints Bay, Guernsey, to provide a telephone channel between England and Guernsey. The new cables provide two telephone circuits between England and Guernsey, and six telephone circuits between England and Jersey.

Progress of the Grid

THE report of the Central Electricity Board for the year 1938 is very satisfactory, although there was a slight reduction in the rate of increase at which electric power is being generated. For the first time since 1932, this rate of increase fell below 10 per cent per annum. The aggregate production is still substantially in excess of the estimates adopted by the Board and those made by the commissioners when planning the various grid schemes. The total output of electricity from public supply stations was 24,400 million units, an increase of nearly 1,500 million units over the previous year. Apparently the stimulus provided by the re-armament programme made up for the loss in demand of the shipbuilding, textile and other industries. At the end of 1938, the grid comprised 4,378 miles of transmission lines, nearly 3,000 miles of which operated at 132 kilovolts, the remainder operating at 66 kilovolts or less. The number of selected stations remained constant at 137 and their total installed capacity was more than 8¼ million kilowatts. During the year, the Board investigated special air raid precautions. It was decided to provide a pool of switchgear, transformers and other equipment, which could readily be made available to replace, temporarily, apparatus that might be damaged. The research work into surges, defective lightning arresters and other troubles arising from atmospheric effects was continued throughout the year. Alterations were also made on switchgear so as to increase their rupturing capacity. The average cost of fuel per ton was 14*s*. 9*d*. in 1937 and 20*s*. 3*d*. in 1938. This increased cost of fuel more than counterbalanced the benefits which would otherwise have accrued to electricity consumers from the improved efficiency of generation.

Electric Development in South Africa

THE rapid economic development of South Africa during the last twenty years is illustrated by the remarkable growth that has taken place in the development of electricity both for industrial and domestic purposes. The extent to which the Union of South Africa is electrified is shown by the sales of electrical energy being 1,670 units per head of population per annum (excluding natives). This figure is twice that for the United States of America and nearly four times the corresponding figure for Great Britain. In a paper on "South African Activity" by H. A. Eastman, published in the *Electrical Review* for June 2, some of the reasons for this rapid and continuing growth are given. Three fifths of the total demand for electricity is due to the requirements for gold mining purposes. When the numerous mines in process of development are brought to the production stage, this will be greatly increased. The use of electricity for other industries and for domestic purposes is also increasing. The average price received by the generating stations is 0·6*d*. per unit. The Electricity Act which came into force in 1922 provided for the establishment of an Electricity Control Board, which is the licensing and controlling authority for all private electricity undertakings. It also controls the Electricity Supply Commission, the members of which are appointed by the Government, but which, nevertheless, is free from parliamentary control. The Electricity Supply Commission operates its undertakings at neither a profit nor a loss and adjusts its charges accordingly. Other licencees are required to refund each year to their consumers, *pro rata* to their payments, 25 per cent of the surplus profits of the undertaking for that year.

Baking Quality Tests for Flour

IN 1934 the Imperial Bureau of Plant Breeding and Genetics published its first bibliography of papers on baking quality tests, which was an immediate success, and in a new supplement recently issued (Imperial Bureau of Plant Breeding and Genetics. Bibliography of Baking Quality Tests, Supplement. Pp. 32. Cambridge: School of Agriculture, 1939. 1*s*. 6*d*.) the Bureau has fully maintained the high standard it set itself in the earlier publication. A list of more than three hundred and thirty titles to original papers is given here, set out in alphabetical order. The list is remarkably complete and no really important communication appears to have been overlooked. One excellent feature of this bibliography which greatly commends it is the translation of the titles of the foreign publications into English. At the present time, extensive investigations are being made in Great Britain and abroad on the physical

properties of dough and its connexion with the baking quality of flour. The baking test, as such, has admittedly many disadvantages, and it is the ultimate aim of workers in this field to supplement the baking test by some other and better standard, and the Imperial Bureau of Plant Breeding and Genetics has rendered a most useful service to those engaged in this particular line of investigation by the publication of this supplement. The bibliography shows almost at a glance where further information may be obtained of what is being done in this highly important and interesting field.

Predatory Birds and their Economic Status

THE British Field Sports Society is pursuing an enlightened policy in endeavouring to educate gamekeepers and others in the identification of predatory birds and in recognizing the economic standing of each species, so that only those seriously harmful to game and other wild birds should be destroyed. In a foreword to a pamphlet of 83 pages, just published by the Society and entitled "Predatory Birds of Great Britain" (price 2*s*. post free), an appeal is made to gamekeepers and their employers to see that the law regarding the protection of such birds is known and enforced, and the knowledge is made easy by lists embodied in the pamphlet showing the amount of protection given in each British country to each predatory bird. The main part of the pamphlet, by Eric Parker, consists of short descriptions of the birds themselves, with illustrations by G. E. Lodge, and brief notes upon range and feeding habits. The last set out very fairly the main character of the birds' food, though we note that the little owl is condemned, contrary to the findings of the Report of the British Trust for Ornithology, that the author does not realize that the damage done by rooks depends not so much upon their numbers as upon the kind of farming where they occur, and that the black-headed gull in Scotland is condemned on the strength of one opinion for its destruction of eggs and young birds. That is an opinion not shared on balance by Scottish county councils, which, by the way, obtain county orders from the Secretary of State for Scotland and not from the Home Secretary.

Agricultural Progress

THE current issue of *Agricultural Progress* (16, Pt. 1, 2*s*. 6*d*.), the official organ of the Agricultural Education Association, which is the most influential body of agricultural teachers and research workers in Great Britain, contains much interesting and instructive matter. The early days and later growth of the South-Eastern Agricultural College at Wye are described in the series dealing with the development of agricultural educational and research institutions, whilst the articles on the teaching of agriculture in schools, county instruction in farm machinery, and the educational value of tours for agricultural students, afford evidence of the real advances that are taking place at the present day on the practical side. Two particularly important topics are very fully dealt with. Mastitis disease, which causes serious losses to the milk industry, is discussed from the point of view of the veterinary surgeon, the cheesemaker and the bacteriologist. Methods of field laboratory diagnosis are explained. The other subject is afforestation, and while one author backs up his protest against the afforestation of farm land with numerous examples of the way in which the Forestry Commission has operated in Suffolk, one of the Forestry Commissioners puts forward the other side of the case. Other articles deal with such matters as the foot-rot diseases in cereals, manganese deficiency in relation to soils and crops, and the separation and analysis of soil clay fractions. A considerable space is devoted to book reviews. *Agricultural Progress* will in future be published twice yearly, in February and September.

Higher Education in Belgium

THE "Fondation Universitaire" was created in 1919 with funds appropriated from the final closing balance of the Commission for Relief in Belgium, of which Mr. Herbert Hoover was president. Last year Mr. Hoover accepted a joint invitation from the Fondation and the universities of Belgium to visit that country, and the occasion was marked by eloquent expressions by representatives of Belgian higher education of their sense of its indebtedness to him and to the United States and the value of the consequent cultural relations between the two countries. One of the principal functions of the Fondation is to make higher education available to poor students by means of loans, generally of 1,500–4,000 francs a year. The Fondation relies for the recovery of the loans on the sense of honour of the recipients. That this confidence is not misplaced is strikingly shown in its recently published annual report by a chart exhibiting the amounts of loans granted and refunds received from 1919 until 1938. In recent years the receipts have equalled or exceeded the grants, the annual total being in the neighbourhood of 800,000 francs. The Fondation's resources are also used for encouraging Belgian students, by means of bursaries, to study abroad, for subsidizing publications and scientific societies, for promoting international exchanges between professors and, since 1936, for the maintenance of a Bureau of University Statistics in which has been merged a commission for the study of overcrowding of the universities and unemployment of 'intellectuals'. This body has formulated recommendations for reforming the content of primary and secondary education, making more stringent the tests for promotion from one class to another, for determining what a secondary school-leaving certificate should imply and for restricting to persons intellectually fit for them admission to institutions of university rank.

The Czechoslovak Research Council

THAT the leaders of science in Czechoslovakia have made every endeavour to continue scientific investigations during the past fateful year is indicated by the fifteenth annual report of their National Research Council. At the annual general meeting in March,

Prof. B. Němec referred to the interruption of scientific work occasioned by the country's loss of territory and institutions. Research activities were therefore upon a restricted basis though, he emphasized, it is necessary for a small nation to maintain its cultural activities at the highest possible level. He urged that renewed efforts be made to utilize all the country's remaining scientific institutions and resources for the continuance of all programmes of research. Dr. Ulrich, secretary of the Council, stated that donations were received from industries, corporations and private individuals so that as many students as funds permitted are being supported in the continuance of their work. Investigations in all branches of the natural sciences are still in progress at the universities and at approved institutes. This report also contains a brief account of work completed during the past year by research workers supported by the National Research Council, and the hope may be expressed that it will now continue uninterrupted by further disturbances.

Medical Research in India

SUMMARIES of some of the medical research work in progress in India are contained in the annual reports of the Indian Institute for Medical Research, Calcutta, and of the Haffkine Institute, Bombay, recently issued. In the former, studies on the cholera vibrio and production and therapeutic value of an anti-cholera serum, and on an anti-typhoid serum, have been pursued. Researches on malaria and kala-azar, and the problem of a nutritional survey of Indian food-stuffs and dietaries, have also been undertaken. The Haffkine Institute is the centre for the preparation of anti-plague vaccine, of which more than thirteen million doses were issued during 1937, and work is in progress to improve the efficiency of this vaccine. A survey of the rat population of Bombay in connexion with the epidemiology of plague brings out the interesting fact that the brown and black rats, forming 70 per cent of the rat population of the city, are now highly resistant to plague, though formerly highly susceptible. In the Anti-Rabic Department, more than three thousand cases were treated, with a mortality of 0·08 per cent.

Division of the Circle

IN the *Askania Review*, the journal of the Askania-Werke A.G. of Berlin, the well-known makers of instruments, there is an interesting and instructive article on 'The Divisions of the Circle'. It is pointed out that all topographic services of the Reich are adopting the division of the circle into 400 grades instead of 360 degrees. A history of the adoption of these units is given. The Babylonians knew that the sun completes the zodiac once within 360 days approximately, so that 1° is approximately the sun's daily travel. The adoption of 360° is advantageous inasmuch as the figure is readily divisible by 2, 3, 4, 5, 6, 8, 10, 12, etc. The resulting arcs of the circle or the angles of 180°, 120°, 90°, 72°, 60°, 45°, 36°, 30°, etc., are of great importance in connexion with regular diagrams as well as in technics. Since the absolute angular unit defines the angle by the ratio of the arc length to the radius, it has no 'physical' dimensions. In Germany, therefore, it is not given any special name. In other Anglo-Saxon countries it is usually called the 'radian'.

Medical Supervision of University Students

IN his inaugural thesis (*Thèse de Paris*, No. 136; 1939), Dr. L. Katz maintains that there is an increasing tendency in modern universities not only to provide a professional centre for students but also to supervise their mode of life, work and health, so that they can pursue their studies under the best conditions. It is in the United States that the oldest and most important university health centres have been founded, the object of which is threefold, namely: (1) to provide the students with a personal medical service including medical examination on joining, medical supervision in the course of their studies and sometimes in the treatment of illness, and medical supervision of sport; (2) to supply all students with an elementary knowledge of hygiene; and (3) to insure a hygienic condition of the universities and the life and work of the students. In European countries a similar movement is on foot, though it has not reached the same development as in the United States. The medical centres in European universities, especially in France, confine their activities to prevention and education.

The Nations and Child Welfare

THE Child Welfare Information Centre of the League of Nations has issued a "Summary of the Legislative and Administrative Series of Documents" received and published in 1938 (League of Nations Pamphlet, 4, 1; 1939. London: Allen and Unwin, Ltd., 1*s*.). This summarizes the principal administrative measures taken or enacted by Governments all over the world, and the progress made in the different countries in the sphere of maternal and child welfare, and of the training and status of social workers specializing in that sphere.

Conference on Spectroscopy

THE seventh spectroscopy conference will be held at the George Eastman Research Laboratories of the Massachusetts Institute of Technology during July 17–19. Papers and discussions on analysis of material by the emission spectrum, absorption spectrophotometry, photographic photometry, biological and chemical effects of spectral radiation, and industrial applications of spectroscopy, are being prepared. Copies of the detailed programme of the conference will be sent on request to anyone interested, but as the attendance at the conference is limited to two hundred, those expecting to attend from a distance are urged to signify in advance their intention of being present. No fee is charged. The usual summer courses on practical and applied spectroscopy will be offered at the Institute during June 12–July 22. Further information can be obtained from Prof. George R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Mass.

Earthquake in Greece

ACCORDING to a *Times* message, a severe earthquake was felt on Wednesday, May 31, with most damage being done near Kalavryta, about midway between Patras and Corinth on the Island of Morea in the south of Greece. The epicentre appears to have been near lat. 38° 1′ N., long. 22° 8′ E. Earthquakes are not uncommon in Greece though some areas are more seismic than others. Recently earthquakes appear to have occurred mostly near Chalcis, north of Athens, but the present shock may indicate that seismicity has again moved south. There is apparently a seismic zone stretching in an east–west direction across Greece and passing through the present epicentre, for Davison noted 306 shocks during 1896 near the Island of Zante, and there was a very severe shock near Corinth on April 22, 1928. Miss Bellamy has also recorded 27 distinct shocks from epicentres between lat. 37·5° N. and 38·5° N., long. 21·5° E. and 23·2° E., during the years 1913–30. In the present instance, a considerable amount of damage was done to property at Kalavryta, but no casualties are reported.

Comets

COMET PONS-WINNECKE (1939 *c*) is rapidly approaching the earth and will soon be visible in a small telescope. An ephemeris is given below from which it will be seen that the nearest approach to the earth will be about July 3, when it will be a little more than 10 million miles away. Towards the end of June it will be close to the moon and will probably be difficult to see as the moon will then be near the full.

	α 1950·0	δ 1950·0	*r*	Δ
June 12	15h. 16·3m.	34° 33′	1·112	0·201
20	31·7	21 24	1·103	0·154
30	16 06·8	− 11 08	1·105	0·117
July 2	16·8	19 26		
4	28·1	27 37		
6	40·8	35 18	1·114	0·119

Dr. M. Davidson and also Dr. E. Buchar have computed a general orbit for Comet Jurlof-Achmarof-Hassel (1939 *d*). It is now established that it has a long period, probably several hundred years.

Announcements

A JOINT meeting of the Division for the Social and International Relations of Science of the British Association and the Manchester Literary and Philosophical Society will be held in the Physics Department of the University of Manchester on June 21, beginning at 11 a.m. Sir Richard Gregory will give an introductory address on "The Aims of the Division", and will be followed by Prof. H. Levy, who will deliver the Alexander Pedler Memorial Lecture on "Social Relations of Science: Principles and Methods of Analysis". In the afternoon, an old-established industry and a new industry which has arisen out of scientific research will be discussed. Dr. F. C. Toy will speak on "The Influence of Science on the Cotton Industry", and Dr. V. E. Yarsley and Mr. E. G. Couzens will speak on "The Plastics Industry". Admission to the meetings will be free without ticket.

THE new buildings of the Department of Glass Technology of the University of Sheffield will be opened by the Right Hon. Lord Riverdale, chairman of the Advisory Council for Scientific and Industrial Research, on June 12.

AT a meeting of the General Council of the British Standards Institution held on May 9 Sir Percy Ashley, formerly secretary and now a member of the Import Duties Advisory Committee, was elected chairman of the Institution for the ensuing year. The annual general meeting will be held at the Dorchester Hotel, Park Lane, W.1, on June 15 at 11.15 a.m.

THE Imperial German Academy at Halle has awarded the Cothenius Medal to Dr. Alfred Vogt, professor of ophthalmology at Zurich, for his pioneer work in certain branches of his speciality.

DR. RAJCHMAN, director of the Section of Hygiene of the League of Nations since 1921, has retired, and has been succeeded by Dr. Gautier of Geneva.

THE DECHEMA, the German Chemical Engineering Society, has removed its offices (Dechema-, Achema- and Standard-office) from Berlin to Frankfurt a.M., Dechema-Haus, Bismarckallee 25. A branch office will remain in Berlin, Haus des Vereins Deutscher Chemiker, Potsdamer Str. 111, Berlin W 35.

THE Mullard Wireless Service Co., Ltd., of 225 Tottenham Court Road, W.1, has sent us a leaflet describing a new Mullard cathode ray tube unit. This unit employs a high-vacuum cathode ray tube with four deflection plates. Owing to the reduction of plate and stray wiring capacities to a minimum, it is suitable for use at all frequencies up to those corresponding to ultra-short radio waves.

AN arrangement has been concluded whereby Johnson, Matthey and Co., Ltd., have acquired a controlling interest in Mallory Metallurgical Products Ltd., and the offices of this company have been removed to those of Johnson, Matthey and Co., Ltd., 78, Hatton Garden, E.C.1. A new factory is being erected at Wembley for the production of the Mallory range of Elkonites and copper alloys for use as electrical contacts, switchgear components and resistance welding electrodes. Dr. L. B. Hunt continues to act as technical manager of the company.

THE Cambridge University Press is about to publish a book by Dr. Lewis F. Richardson entitled "Generalised Foreign Politics". This is a more complete version of Dr. Richardson's address to the British Association last year, in which he applied mathematical methods to problems of international relations.

ERRATUM. In NATURE of May 27, p. 885, col. 2, line 16, for "square centimetre" read "square metre".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 985.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The F_2 Region as an Indicating Mechanism for Solar Activity

THE fact that F_2 region critical frequencies and solar activity correlate in a general way is well known. Moreover, I have shown[1] that the effect of changes in ionization which occur throughout the year can be eliminated in such a way as to bring out a clear-cut correspondence between these critical frequencies and smoothed average sunspot numbers. In an effort to find a more sensitive index for correlation purposes, a study has been made using both whole disk and central zone character figures for calcium and hydrogen flocculi as well as relative sunspot numbers. It has been found that the central zone indexes are better than those for the whole disk. When the monthly averages of the character figures for calcium flocculi are used, it is found that no smoothing is necessary, provided the effect of changes that occur throughout the year is eliminated.

The data used in this study consisted of monthly average values of the central zone character figures for calcium flocculi, and the monthly average for undisturbed days of the critical frequency values, giving equal weight to all hours of the day. The calcium character figures were obtained from the bulletins of the International Astronomical Union, while the radio data for Washington, D.C., have been published by the National Bureau of Standards in various issues of the *Proceedings of the Institute of Radio Engineers*.

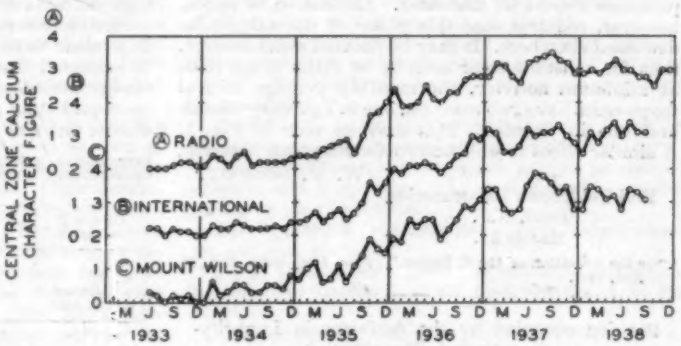


Fig. 2.

CENTRAL ZONE CHARACTER FIGURES BASED ON OBSERVATIONS OF CALCIUM FLOCCULI AND RADIO MEASUREMENTS.

The radio data show a progressive variation from one month to the next during periods of constant solar activity. This variation may be separated from that due to solar activity by plotting the data for each of the twelve months separately. This is done in Fig. 1, where for each month the radio data are plotted against the character figure for that month.

Having obtained the straight lines of Fig. 1, we now use these curves and the radio data to obtain a radio character figure for solar activity. This character figure is plotted in Fig. 2 along with the calcium figures for: (1) the average of several observatories (international) and (2) the value obtained at Mt. Wilson. It is seen that the general trend of all three curves is substantially the same. The curves for the Mt. Wilson data and the radio data indicate a maximum in 1937, while the middle curve indicates a less pronounced maximum for 1938. In this respect the curves for Mt. Wilson data and the radio data are alike. In general, it may be concluded that the radio data give a reasonably good measure of solar activity.

From one point of view we may regard the F_2 region of the ionosphere as an indicating mechanism for solar activity. In the case of the character figures, the calcium flocculi observations are made directly in the sunlight. In the case of the radio observations, the solar effect causes the ionization of the F_2 region and the measurements are

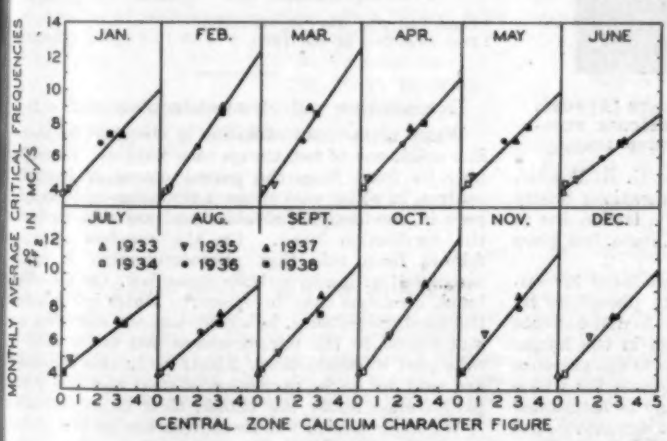


Fig. 1.

MONTHLY CORRELATION CHARTS: AVERAGE CRITICAL FREQUENCIES AND CENTRAL ZONE CALCIUM CHARACTER FIGURES.

made by observing the critical frequencies of this region. Since the critical frequencies are a measure of the ionization, it is seen that this whole process is merely a different way of measuring solar activity. Of course we would not be justified in using this method if other factors entered in such a way as to confuse the result. It is believed that the correlation results shown in this note indicate that other factors, if present, can be ignored, at least to the first approximation.

From the point of view of the ionosphere, there are a number of interesting points which for completeness should be discussed. Limitation of space, however, requires that this phase of the subject be discussed elsewhere. It may be pointed out, however, that for constant solar activity at other times than at minimum activity, the monthly average critical frequencies have two maxima, one in February–March and one in October. This may be seen in Fig. 1. A similar effect is well known for magnetic activity.

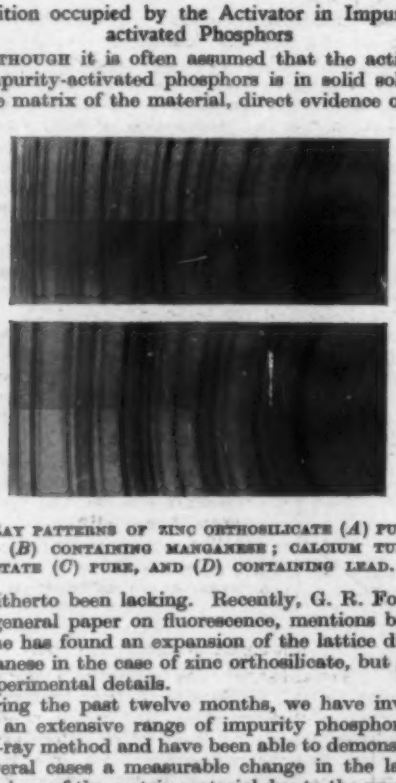
W. M. GOODALL.

Bell Telephone Laboratories,
Deal, N.J.
March 31.

[1] "On the Ionization of the F_2 Region." *Proc. Inst. Radio. Eng.*, **25**, Nov. 1937.

Position occupied by the Activator in Impurity-activated Phosphors

ALTHOUGH it is often assumed that the activator in impurity-activated phosphors is in solid solution in the matrix of the material, direct evidence of this has hitherto been lacking. Recently, G. R. Fonda[1], in a general paper on fluorescence, mentions briefly that he has found an expansion of the lattice due to manganese in the case of zinc orthosilicate, but gives no experimental details.



X-RAY PATTERNS OF ZINC ORTHOSILICATE (*A*) PURE, AND (*B*) CONTAINING MANGANESE; CALCIUM TUNGSTATE (*C*) PURE, AND (*D*) CONTAINING LEAD.

During the past twelve months, we have investigated an extensive range of impurity phosphors by the X-ray method and have been able to demonstrate in several cases a measurable change in the lattice dimensions of the matrix material due to the presence of the activator. Among the phosphors for which lattice changes have been detected may be mentioned zinc beryllium orthosilicate, calcium tungstate and zinc orthosilicate.

The X-ray patterns were taken in a 10 cm. diameter diffraction camera of the type described by Bradley and Jay[2], with knife edges arranged to cast a shadow at an angle of 170°. *A* and *B* in the accompanying reproduction illustrate the difference between pure zinc orthosilicate and a zinc orthosilicate containing 2½ per cent manganese by weight added as manganese nitrate. The displacement of the lines away from the knife edge shadow from the positions for the pure material, corresponding to a lattice expansion, will be noted. The magnitude of the lattice expansion can be seen from the accompanying table, in which the interplanar spacings for two or three lines at the high diffraction angle end of the X-ray patterns for three different percentages of manganese are recorded. It is clear that this is the kind of lattice change to be expected from the replacement of zinc atoms by manganese atoms, and the activated phosphor can be regarded as a solid solution of manganese orthosilicate and zinc orthosilicate.

INTERPLANAR SPACINGS NEAR DIFFRACTION ANGLE 85° FOR ZINC ORTHOSILICATE ACTIVATED BY VARIOUS PERCENTAGES OF MANGANESE (COPPER $K\alpha$ RADIATION).

Copper *K* radiation	0% manganese	1% manganese	2½% manganese
α_1	0·7723$_2$	0·7728$_8$	0·7733$_2$
α_1	0·7739$_0$	0·7745$_5$	0·7753$_8$
$\alpha_1\alpha_2$ (mean)	0·7867$_1$	0·7873$_5$	0·7878$_1$
$\alpha_1\alpha_2$ (mean)	0·7911$_4$	0·7917$_6$	0·7923$_1$

Calcium tungstate is representative of a class of phosphor in which the deliberate introduction of an activator is not essential for the production of luminescence. Lead is, however, sometimes used as an activator in calcium tungstate, the effect being to shift the centre of gravity of the fluorescent band towards longer wave-lengths. The X-ray patterns in *C* and *D* clearly show the solid solution effect in the case of calcium tungstate activated by approximately 3 per cent by weight of lead.

It is hoped to publish the results in more detail elsewhere.

H. G. JENKINS.
A. H. MCKEAG.
H. P. ROOKSBY.

Research Laboratories,
General Electric Company, Ltd.,
Wembley.
April 20.

[1] *Trans. Inst. Elec. Eng.*, **57**, 677 (1938).
[2] *Proc. Phys. Soc.*, **44**, 563 (1932).

Luminescence and Photoconductivity of Solids

WHEN ultra-violet radiation is absorbed by atoms in a solid, one of two things may happen. Electrons may be freed from the parent atoms or impurity centres, in which case these electrons are able to take part in conduction processes and are said to be in the conduction band. On the simplest view, it follows from this that photoconduction is to be associated with a hyperbolic decay law. On the other hand, electrons may be raised to states lying below the conduction band, in which case the electrons are still bound to the parent atoms and are unable to take part in conduction. Electrons in this condition are said to be in excitation states, and the phosphorescence decay law should then be exponential.

We have carried out measurements on the photoconductivity and phosphorescence decay curves of a large number of luminescent solids, and from the results have obtained direct evidence of excitation

states in uranyl salts and tungstates, and also in a number of impurity compounds activated by manganese and chromium.

Uranyl salts, as was to be expected, show no photoconductivity, and the exponential phosphorescence decay curves are in agreement with the idea[1] that the luminescence of these salts is a result of the absorption of energy within the co-ordination group of the uranyl ion.

The tungstates of calcium, magnesium and zinc do not show photoconduction under radiations giving rise to strong fluorescence. This new fact, together with the exponential decay[2], supports the suggestion that the luminescence of these compounds is similar in origin to that of the uranyl salts, and arises from transitions between the excitation states and the ground state of the WO_4 ion.

It has recently been shown by one of us[3] that the fluorescence of pure manganous compounds, and of solids activated by manganese, is in many instances due to transitions within the Mn++ion. Our measurements on photoconductivity and phosphorescence have now confirmed this view. Pure manganous chloride ($MnCl_2$) is not photoconducting, neither are the compounds cadmium chlorophosphate, cadmium borate, cadmium silicate, or zinc mesodisilicate when activated by manganese. We have also measured the phosphorescence decay curves for these compounds and find them to be exponential. Other examples of non-photoconducting solids we have found are alumina with chromium impurity (ruby), and pure calcium oxide.

As the fluorescence spectra of the uranyl salts, the ruby, and calcium oxide are of the well-resolved type, it would appear that this type of spectrum is in general to be associated with lack of photoconduction.

It is well known that luminescent energy can be stored in certain phosphors at low temperatures; this energy is released on warming the solid. We find that solids showing this effect of 'thermal glow' to any marked extent are photoconducting solids such as willemite and the zinc sulphides. Non-photoconducting solids show little or no thermal glow.

In zinc sulphide phosphors we find also that it is the long period phosphorescence that is enormously delayed by cooling. The medium period decay of the order of milliseconds takes place rather more rapidly when the solid is cooled to 90° K.

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M. H. F. WILKINS.

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May 22.

[1] Randall, *Trans. Farad. Soc.*, **35**, 13 (1939).
[2] Strange, *Trans. Farad. Soc.*, **35**, 95 (1939).
[3] Randall, *Proc. Roy. Soc.*, A, **170**, 272 (1939).

Spectrographic Analysis of Three Arthropods

Two species of insects and one species of chilopod have been analysed by the methods[1] developed in the spectroscopic laboratory of the Experiment Station of the Hawaiian Sugar Planters' Association. These methods give information only on the metallic and semi-metallic elements present in the sample. Although the analyses are essentially qualitative, clear distinctions between the major, minor and trace constituents can be made.

The specimens analysed were selected to cover a wide range of feeding habits. They included sugar cane beetle borers (*Rhabdocnemis obscura* (Boisd.), segregated according to sex); large common centipedes (*Scolopendra subspinipes* Leach); and cypress cockroaches (*Diploptera dytiscoides* Serville). The beetle borers are plant feeders, spending all their lives except the adult stage within sugar cane stalks. The centipedes are predators, feeding principally on small insects. The cockroaches are omnivorous scavengers; the particular ones analysed were found in dusty soil under stones and bits of refuse. None of these species is indigenous to Hawaii.

The specimens were washed in boiling distilled water and then ashed in platinum for six hours at 500° C. Two-milligram samples of the ash were used in analysis.

A similarity in metallic constitution was found for the three species, the general composition being:

Chief constituents: Phosphorus, silicon, potassium, calcium and magnesium (the chief mineral elements found in plant material).

Less plentiful constituents: Iron, manganese, copper and sodium.

Trace constituents: Zinc, aluminium, strontium, barium and titanium. (No titanium found in the centipede ash.)

Four additional trace elements were found in the cockroach ash, namely, lead, boron, chromium and nickel. In addition, this ash was strongest in iron, silicon, aluminium, and perhaps calcium and potassium. On the other hand, the centipede ash contained the *least* of the chief soil elements, iron, aluminium and titanium, and of the plant material elements silicon, potassium and perhaps manganese. The beetle borer ash was strongest in barium, and showed a trace of tin. No differences between the composition of male and female borers were noted.

The large number of mineral elements present in the cockroach ash, and the heavier concentration of metals in this sample, suggests a correlation between feeding habits and metallic composition.

Ash analysis results for several other species of insects have been compiled by Uvarov[2].

Thanks are due to Mr. R. H. Van Zwaluwenburg, associate entomologist at the Experiment Station, for suggesting these analyses and for furnishing the specimens.

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[1] Ballard, S. S., *Phys. Rev.*, **52**, 253 (1937).
Uvárov, B. P., *Trans. Entom. Soc. London*, **76**, 276–281 (1928).

Ionization in the Troposphere

W. KOLHÖRSTER[1] has recently expressed the opinion that G. A. Suckstorff's measurements[2] have proved the existence in the troposphere of additional ionization caused by radioactive substances to be found in the temperature inversion layers. Suckstorff found in the higher layers of the troposphere enormous oscillations of ionization, amounting sometimes to 50 per cent of the measured value. The amplitudes of these oscillations increased with height; thus, Suckstorff formed the opinion that the oscillations were due to radioactive substances of extra-terrestrial origin present in the upper troposphere.

In order to obtain more information concerning this question, analogous measurements have been carried out. During three balloon flights (March 26, 1936 and June 18, 1936, results still not published; May 14, 1938) the ionization was explored[1] between 6 km. and 10 km., within which range Suckstorff has detected the greatest oscillations.

Within the limits of observational errors (generally a few per cent) quite smooth curves have been obtained, displaying no irregularities. The most convincing results were obtained in the last flight, when two ionization pressure chambers were used, filled with krypton and nitrogen, respectively, the specific ionization in nitrogen and krypton being quite different for cosmic and radioactive gamma rays[4]. The velocity of the ascent of the balloons was of the same order of magnitude as in Suckstorff's flights (in the first flight it was even less). The apparatus used were at least twenty times more sensitive than that used by Suckstorff. We are compelled to assume that the oscillations observed by Suckstorff were due to some instrumental faults.

As regards the anomalies observed by J. Juilfs[5] in his measurements carried out in the lower troposphere (up to the height of 5·7 km.), we agree that radioactive substances of terrestrial origin are not unlikely to cause deviations in the ionization curve from its normal shape. It would be highly desirable to have these interesting observations repeated with modern sensitive instruments.

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April 25.

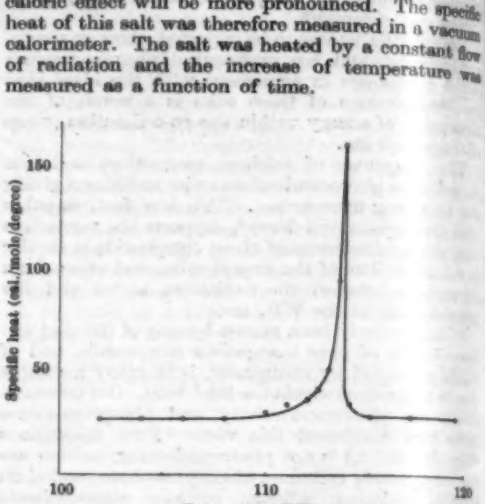
[1] Kolhörster, W., *Naturwiss.*, **27**, 243 (1939).
[2] Suckstorff, G. A., *Phys. Z.*, **35**, 365 (1934).
[3] Ziemecki, S., and Narkiewicz-Jodko, K., NATURE, **137**, 944 (1936). Szczeniowski, S., Ziemecki, S., and Narkiewicz-Jodko, K., NATURE, **142**, 208 (1936). For more details, see *Bull. Acad. Polon.*, A, 318 (1936), and 273 (1938).
[4] Juilfs, J., NATURE, **140**, 767 (1937). Szczeniowski, S., Ziemecki, S., and Narkiewicz-Jodko, K., *Bull. Acad. Polon.*, A, 273 (1938).
[5] Juilfs, J., *Naturwiss.*, **26**, 789 (1938).

Anomaly of the Specific Heat of Potassium Dihydrogen Phosphate at the Upper Curie Point

THE dielectric properties of Rochelle salt, potassium dihydrogen phosphate and potassium dihydrogen arsenate, depend on the electric field in the same way that the properties of ferromagnetic substances depend on the magnetic field. The spontaneous polarization is large between the two Curie points and depends on temperature. Approaching the higher (normal) Curie point from lower temperatures, the spontaneous polarization vanishes. As a consequence the specific heat shows an anomaly, corresponding to the magneto-caloric effect in ferromagnetics.

This anomaly was found by Kobeko and Nelidow[1] and Rusterholz[2] in Rochelle salt. Wilson[3] and Hicks and Hooley[4], however, could not detect it. The variation of the spontaneous polarization as a function of temperature is so slow, that the anomaly of specific heat is spread over a wide temperature range and therefore the deviations are small. Although the maximum of specific heat measured by Rusterholz was considerably higher than was expected from the theory, the total anomalous heat capacity $\int \Delta C \, dT$ agrees well with the values calculated from recent results of the spontaneous polarization (Hablützel[5]).

As the change of spontaneous polarization of potassium dihydrogen phosphate is larger and more rapid with temperature, it is probable that the electro-caloric effect will be more pronounced. The specific heat of this salt was therefore measured in a vacuum calorimeter. The salt was heated by a constant flow of radiation and the increase of temperature was measured as a function of time.



SPECIFIC HEAT OF POTASSIUM DIHYDROGEN PHOSPHATE

The results plotted in the accompanying graph show a strongly marked anomaly of specific heat of about 130 cal./mole/degree. The integral $\int \Delta C \, dT$ representing the energy necessary to destroy the internal field, was found by this method to be 60 cal./mole. With this value and a maximum polarization $P_{max.} = 4{\cdot}3 \times 10^{-6}$ coulombs/cm.[2] measured by Busch[6], the Lorentz value f is found to be 0·5, applying the Langevin-Weiss formula $\int \Delta C \, dT = \frac{1}{2} f P^2_{max.}$. This is in fair agreement with the value $f = 0{\cdot}4$ calculated by Busch from dielectric investigations.

The variation of the specific heat as a function of temperature can be calculated from the differential Langevin-Weiss formula. Owing to the rapid increase of $P_{spont.}$ as a function of temperature, it is therefore not possible to give an exact maximum value of ΔC, but the agreement between observed and calculated values is fairly satisfactory. It is intended to investigate potassium dihydrogen arsenate and also the effects at the lower Curie point.

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May 4.

[1] Kobeko and Nelidow, *Phys. Z. d. Sowjetunion*, **1**, 382 (1932).
[2] Rusterholz, *Helv. phys. Acta*, **8**, 39 (1934).
[3] Wilson, *Phys. Rev.*, **54**, 1103 (1938).
[4] Hicks and Hooley, *J. Amer. Chem. Soc.*, **60**, 2994 (1938).
[5] Hablützel, *Helv. phys. Acta*, in the Press.
[6] Busch, *Helv. phys. Acta*, **11**, 269 (1938).

Crystal Structure of Diphenyldiacetylene

DIPHENYLDIACETYLENE ($C_6H_5{-}C{\equiv}C{-}C{\equiv}C{-}C_6H_5$) crystallizes from acetic acid in monoclinic prisms. From rotation-, Weissenberg- and Laue-diagrams the symmetry and dimensions of the unit cell have been determined.

$a = 6{\cdot}61$ A.; $b = 6{\cdot}04$ A.; $c = 14{\cdot}92$ A.; $\beta = 105°$.

With two molecules per unit cell the density should be 1·163, observed density 1·16$_3$. The most probable space group is C_{2h}^5 ($P_{21/c}$).

As C_{2h}^5 has four equivalent sets of two-fold positions, the centres of symmetry of the two molecules may be put at 000 and $0\frac{1}{2}\frac{1}{2}$. By the method of trial and error the following details were found. The long axes of the molecules form angles of 42°, 38° and 78° with the *a*, *b* and *c* axes respectively. Within the limits of error the molecules are flat with straight carbon chains; the planes of the phenyl rings of the two sets of molecules are not parallel with each other or with one of the basal planes. The lengths of the primary bonds are in accordance with experience. The smallest distance between carbon atoms of two different molecules is 3·45–3·65 A.; it occurs between carbon atoms of the phenyl groups. It thus seems that the forces of cohesion are acting mainly between these.

A Fourier synthesis is in progress with the aim of specifying the shape of the carbon chain, especially the length of the 'single' bond in the middle of the molecule. It will be interesting to compare the complete structure with the results of Robertson and Woodward's investigation[1] of the structure of tolane (C_6H_5–C≡C–C_6H_5).

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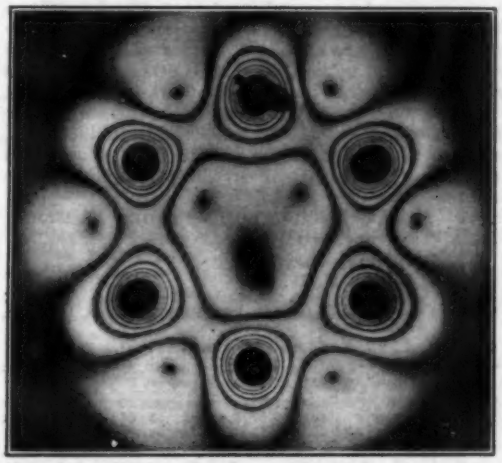
[1] Robertson and Woodward, *Proc. Roy. Soc.*, A, 164, 436–446 (1938).

Centrifugal Stresses in Rotating Disks

IN recent experiments at this laboratory, the photo-elastic method has been successfully applied to the determination of centrifugal stresses in rotating disks. The new technique depends upon the double structure of Bakelite BT-61-893[1]. Bakelite consists of two phases, one of which (the *A* phase) fuses at relatively low temperatures. If a sample is heated, the viscosity of the *A* phase is rapidly lowered until it becomes virtually negligible at about 115° C., whereas the *C* phase is little affected. At this temperature the modulus of elasticity is reduced to 1/640 of its value at room temperature and the stress-optical coefficient is increased twenty-five times. If the specimen is subjected to external load at this temperature, and allowed to cool slowly to room temperature while still under load, the deformation and photo-elastic optical effect are 'frozen in'. This is brought about by the solidification of the liquid *A* phase within the space lattice formed by the *C* phase. Subsequent removal of load leaves the deformation and optical pattern virtually unaltered.

Use is made of these properties by spinning (at constant speed) a Bakelite model of the rotor to be studied, raising its temperature to about 110–115° C., and slowly cooling to room temperature. The specimen may then be removed from its mounting and studied while at rest. This technique eliminates the tremendous handicaps of the stroboscopic method, which has the disadvantage of requiring high speeds, high intensity of illumination, and extremely accurate synchronization. A stroboscopic study also requires the construction of a mounting which permits the viewing of the central portion of the disk during rotation—a great hindrance because the axis of rotation and the axis of the polariscope must be practically coincident. The increased optical sensitivity at an elevated temperature makes possible the use of relatively low speeds and small models (the accompanying photograph was made of a model 5½ in. in diameter and 1 in. thick; speed, 1,800 r.p.m.). The technique is applicable to all problems of centrifugally induced stress distributions where the speed of the rotor is constant.



A more detailed account of these investigations will be published upon completion of the current experiments.

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April 22.

[1] For a complete account, see Hetenyi, M., "The Fundamentals of Three-Dimensional Photoelasticity", *J. App. Mech.* (Dec. 1938).

Does the Rabbit Chew the Cud?

SOME years ago my attention was directed to a paper by Morot (1882)[1] (carefully abstracted by A. V. Wille[2]). It seems to have been overlooked in physiological literature. Since his results seemed strange, I carried out some experiments to test them.

Morot stated that rabbits produce two sorts of fæces, the first during the night—soft, mucous; the second during the day—of the familiar appearance. The night fæces are taken directly from the anus, and without being chewed, swallowed like pills. These pills, which are regularly met with in the stomach (a well-known fact), are only seen free when the animals are prevented from getting at their anus.

That Morot's claims were correct was shown in two ways. I provided a rabbit with a wooden collar, which allowed it to jump around a little. In a cage with wire mesh floor two sorts of fæces immediately appeared in a day – night rhythm. Nine rabbits were fed simultaneously with fig seeds and killed intermittently. It appeared that the food in about twenty-four hours had passed through the intestines twice. An especially convincing case was presented by a rabbit, which was killed at 3 o'clock in the morning.

It had 'stomach buns' both in the rectum and in the stomach, and in both was found a nematode, *Passalurus ambiguus*, being a common cæcum and colon parasite. Morot was of opinion that the difference in consistency of the two sorts of fæces is due to the food having passed once or twice. But since the two sorts were still produced by a collared rabbit even after a month, the difference in consistency must be due to an intestinal rhythm in the rabbit itself.

In the physiological literature it is commonly known that rabbits are coprofagous[3]; but it has not been commonly acknowledged that this is really a fully normal and regular physiological process. Some points in literature seem to show that similar processes are found in guinea pigs and other herbivorous rodents[4]. Further investigations are to be directed towards the meaning of this peculiar process in the form of analyses of the contents of digestible matter, salts and vitamins in the two sorts of fæces. An analysis of the intestinal rhythm would seem to be of great interest[5].

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March 28.

[2] Morot, Ch., "Des pelotes stomacal des Hyperidés," *Mém. Soc. centr. méd. vét.*, 12, Sér. 1 (Paris, 1882).

[3] Wille, V. A., "Does the Hare Chew the Cud?" (London, 1932).

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[4] Krzywanek, W., "Vergleichende Untersuchungen über die Mechanik der Verdauung" (3-4), *Arch. Tierheilk.*, **55**, 523-536, Fig. 15; **56**, 537-556, Fig. 25; **56**, 40-61, Fig. 6 (Berlin, 1927).

[5] Hemmingsen, A. M., and Krarup, N. B., "Rhythmic Diurnal Variations in the Œstrous Phenomena of the Rat and their Susceptibility to Light and Dark", *Kgl. D. Vidensk. Selsk. Biol. Medd.* (XIII), 7, 1-61 (1937).

THE curious food pellets described by Morot and mentioned in Dr. Madsen's letter must be familiar to all laboratory workers who have occasion to open the rabbit's stomach. They have frequently been seen in the parasitological department of this Laboratory during the course of work carried out on the stomach worm *Graphidium strigosum*, and we have wondered how it could be possible for the mucous membrane of a large hollow organ to form such perfectly rounded pellets.

The explanation given by Morot and confirmed by Dr. Madsen was new to us and at first we were inclined to regard it as too fantastic for serious consideration; the pellets frequently constitute more than one third of the stomach contents and refection to such a degree seemed too improbable for us to believe it without further proof. In view of the importance of the rabbit as an experimental animal and the significance of information on such a point to workers in nutrition or in parasitology, one or two observations were made at this laboratory to ascertain whether there was a sound foundation for Morot's theory.

Although in arranging these experiments we did not expect to be able to confirm Morot and Madsen's observations, we acknowledged in the end that in all probability their conclusions are correct, and that, presumably, for reasons of the digestion of cellulose, the rabbit is in the habit of swallowing large amounts of its own fæces in bolus form directly from the anus, so providing an example of physiological refection to a more marked degree than had previously been thought to exist.

This point in the special physiology of the rabbit is of considerable significance for the correct interpretation of metabolism experiments in which this animal has been used, and there can be little doubt that the observation brought forward by Morot and Madsen will invalidate some and perhaps many of the conclusions that have been arrived at in past metabolism experiments on this animal.

A series of observations on the fate of ingested copper recently carried out on the rabbit at this laboratory might be cited as a case in point. It was found that the excretion of copper in the fæces, following an experimental feed, was spread over a period of between four and five weeks, and it had been tentatively concluded that in all probability the copper is temporarily stored in the intestinal mucous membrane and gradually passed into the intestine by a process of exfoliation of the cells. It now appears that a more rational explanation would be the repeated refection of the copper-containing fæces.

The few observations made at this laboratory may be briefly stated as follows:

Examination of the stomach pellets in a few rabbits showed them to be of varying sizes ranging from 0·2 to 1·0 cm. in diameter, more or less spherical, soft in consistency, coated with a thin layer of mucus and so well separated from one another that they fall apart when shaken out of the opened stomach. They occur almost invariably at the cardiac end, composing up to one half of the stomach contents, but a few pellets may sometimes be found mixed with the general mass.

An observation made on three muzzled and three control rabbits kept in individual cages overnight showed that two kinds of fæces had been passed in both experimental and control groups, which was contrary to the refection theory.

Rabbits are almost invariably infected with coccidia in the mucous membrane of the intestine and frequently in the liver, but not in the mucous membrane of the stomach. Examination of the stomach pellets, however, showed them to contain large numbers of coccidial oocysts, not quite so many as were found in the fæces of the same rabbit, but eight or ten times as many as could be found in the general mass of the stomach contents. This was greatly in favour of the refection theory.

Examination of the stomach contents forty-eight hours after an experimental feed containing *Lycopodium* spores[1] showed many spores still to be present. As the stomach of a control rabbit fasted overnight contained very little food indeed, this observation is also suggestive of refection.

None of the observations, however, quite ruled out the possible explanation of the presence of oocysts or spores in the stomach as the result of the casual refection that might occur in an animal confined to a small cage. Another observation was therefore made on a series of six rabbits that were first fasted for 48 hours; three of these were then fastened into rubber bags leaving only their heads uncovered and all were given food *ad lib.* Post-mortem examination on the following morning revealed the presence of numerous stomach pellets in all three of the control rabbits, and the complete absence of stomach pellets from the stomachs of the rabbits that had been tied into bags. Numerous coccidial oocysts were also found in the stomach pellets of the control rabbits but oocysts were absent from the stomach contents of the other three, which appeared to prove the fæcal origin of the pellets.

We were therefore led to conclude that the rabbit practises physiological refection to a very marked degree, between one third and one half of the stomach contents normally being of faecal origin. This observation has an important bearing on the interpretation of results of metabolism experiments in the rabbit.

I look forward with much interest to the publication of Dr. Madsen's further observations.

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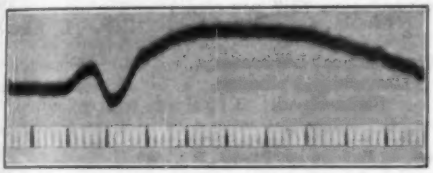
[1] NATURE, 135, 435 (1935).

Owls and Infra-Red Radiation

IN a paper published in 1934, F. L. Vanderplank[1] records certain observations which are interpreted as showing that the tawny owl, *Strix aluco* L., is able to perceive infra-red rays visually, and thus to see in total darkness the small animals on which it preys.

To test this possibility we have carried out the following experiments on the eye of a tawny owl.

(1) In the intact animal (under urethane anæsthetic) we recorded, with an oscillograph and suitable amplifying system, the retinal potential produced in response to stimulation by white light, using an electric bulb as source. There is a large and clearly marked response, as in other animals.



RETINAL RESPONSE OF THE DARK-ADAPTED EYE OF THE TAWNY OWL TO SUDDEN ILLUMINATION OF APPROXIMATELY SIX FOOT-CANDLES.

Electrodes on the cornea and in the mouth. 1 cm. = 150 microvolts. Time, 0·02 sec. intervals.

No potential could be detected, even with the highest possible amplification, in response to stimulation by infra-red radiation from a large black body at 40°–400° C. close to the eye.

(2) We placed the eye of a tawny owl, immediately after removal from the animal, between a source of infra-red rays and a sensitive Moll thermopile. The sclerotic and retina were removed, so that the cornea, lens and humours were in the path of the rays. When the eye was interposed, we could detect no response from the thermopile, and if any transmission occurred it was less than 0·5 per cent.

We obtained consistently negative results in both experiments, using a black radiating body as source at temperatures from 40° C to about 400° C. Transmission through the mammalian eye[2] practically ceases for wave-lengths longer than 15,000 A., and we conclude that the eye of the tawny owl, like that of other animals that have been examined, is opaque to long infra-red rays. Even if the retina should be sensitive to long infra-red rays, none can reach it in the undamaged eye.

Our experiments lend no support to the view that the owl can see a small animal in darkness by its own infra-red radiation.

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[1] Vanderplank, F. L., *Proc. Zoo. Soc. London*, 505–507 (1934).
[2] Roggenbau, C., and Wetthauer, A., *Klin. Monat. f. Augenheilk.*, **79**, 456 (1927).

Specificity of the Evocator in *Hydra*

TISSUE from *Hydra viridis* boiled in water for ½–1 minute and implanted into the blastocœle of *Triton* gastrulæ evocates the formation of neural tissue and in some cases neural tubes[1].

Thirty years ago, Browne[2] observed that the implantation of peristome tissue, or the material of a regenerating hydranth, or tissue from a bud in *Hydra viridis* resulted in the outgrowth of a new hydranth. Grafts of tissue from other regions of the *Hydra* body and wounds gave negative results. These results were confirmed by Rand, Bovard and Minnich[3] for *Hydra oligactis* (*fusca*).

Child[4] has produced supernumerary hydranths in another hydrozoan, *Corymorpha*, by lacerations and by the grafting of various regions of the stem. Santos[5] has produced supernumerary heads in planarians by the implantation of cephalic ganglion region. Supernumerary heads have developed in planarians following such diverse stimuli as laceration, faradic stimulation and cautery[6].

In view of the reactions of *Corymorpha* and of the planarians, and since *Hydra* is known to possess an extremely high regenerative potency, it was believed that supernumerary hydranths could be produced by some means other than the transplantation of the tissues noted by Browne (*loc. cit.*). The techniques which had yielded successful results on planarians were used on *Hydra oligactis*.

A toothpick, the tip of which had been sharpened to a very fine point, was dipped into 70 or 80 per cent ethyl alcohol and the tip was then applied to the tissue of the mid-region of individuals of *Hydra*. In others, the tissue in the same region was lacerated with a finely pointed cataract knife, and in a third group a heated micro-cautery needle was lightly touched to the *Hydra* tissue. Supernumerary hydranths did not develop in any of the 150 treated animals which continued to live after the injury without any apparent ill-effects.

Why *Hydra* should react only to a specific stimulus is not clear to me. Other agents which have been used successfully on other forms will be tried on *Hydra*.

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April 21.

[1] Waddington, C. H., and Wolsky, A., *J. Exp. Biol.*, **13**, 92 (1936).
[2] Browne, E. N., *J. Exp. Biol.*, **7**, 1 (1909).
[3] Rand, H. W., Bovard, J. F., and Minnich, D. E., *Proc. Nat. Acad. Sci.*, **12**, 565 (1926).
[4] Child, C. M., *Physiol. Zool.*, **2**, 342 (1929).
[5] Santos, F. V., *Physiol. Zool.*, **4**, 111 (1931).
[6] Goldsmith, E. D., *Proc. Nat. Acad. Sci.*, **20**, 555 (1934).

Presence of Cancer-producing Substances in Roasted Food

A SERIES of mice was painted every second day for a long time in the ordinary manner in the occipital region with an alcohol or petroleum extract (*a*) of horse muscle, treated at a temperature of 275° C., (*b*) of browned butter, or (*c*) of roasted coffee. As controls we employed (*a*) a series of mice painted in the same manner with an alcohol or petroleum ether extract of horse muscle dried on a water bath or in a hot current of air, untreated butter and unroasted coffee, and (*b*) a number of untreated animals.

The experimental series have so far comprised 241 animals—149 males and 92 females. The spontaneous frequency of malignant tumours among the females is 10 per cent at most. Among the males this frequency is, as usual, much lower.

So far, no malignant tumours have been observed in the male mice painted with extract of either roasted or unroasted food. On the other hand, a giant-cell spindle-cell sarcoma was produced in the painted region in a series of mice which had been painted for a long time with pure cholesterol, treated at 275° C., emulsified in coco-nut fat. Further, certain chronic changes of great interest, which will be described later, were observed in the animals treated with roasted food.

Twenty-three of the female mice treated with extracts of roasted food survived a period of application of 11 months. In this period we observed nine malignant tumours in the mammary glands, all of the adenocarcinoma type (= 40 per cent), namely, two after the application of petroleum ether extract of roasted coffee, one after browned butter, two after petroleum ether extract of roasted muscle and four after the application of an alcohol extract of roasted muscle. The average time for the appearance of these tumours was 360 days. In the control series (26 animals) only one case of mammary cancer (= 4 per cent) was observed during an observation period of 378 days.

The statistical probability of such a distribution of the tumours (9 tumours in 23 animals treated with an extract of roasted material and 1 in 26 animals in the control series) occurring simply by chance is not more than 0·0026, that is, the chance of this occurring in such series is only one in 380. Moreover, as the tumour frequency has increased to 40 per cent, as compared with the maximum expected incidence of 10 per cent, the probability that chance has played a part is much less, and on that account I consider that I am justified in concluding from the results of these experiments that extracts of roasted food contain one or more carcinogenic substances.

These substances may be thought to reach the mammary tissue by resorption from the skin. However, very little change was noticed in the skin during the entire period of application. Cramer and Horning[1] and Burrows[2] have produced mammary cancer in mice by the application of œstrone. Attempts to demonstrate the presence of an œstrogen factor in the extract, however, have not yet given any positive results. Another possibility is that the carcinogenic factor reaches the organism *per os*, as the animals very quickly lick off the painted extract. The isolation of the active substance is in progress. A full report will be published in the *Proceedings of the Royal Physiographical Society of Lund*.

The present investigation was suggested by the observations of Kennaway[3,4] and Kennaway and Sampson[5] that heating human skin, muscle, yeast and cholesterol in a hydrogen atmosphere to 700°-920° C. produces carcinogenic substances with a local effect.

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April 15.

[1] Cramer, W., and Horning, E. S., *Lancet*, **230**, 247 (1936).
[2] Burrows, H., *Amer. J. Cancer*, **24**, 612 (1935).
[3] Kennaway, E. L., *J. Path. Bact.*, **27**, 233 (1924).
[4] Kennaway, E. L., *Brit. Med. J.*, **11**, 1 (1925).
[5] Kennaway, E. L., and Sampson, *J. Path. Bact.*, **31**, 609 (1928).

Influence of Lactate on the Absorption of Glucose from the Intestine of Adrenalectomized Rats

IN experiments designed to throw light on the mechanism of sugar absorption and its control by the adrenal cortex, it was previously found[1] that with adrenalectomized rats sodium pyruvate restores the normal sugar absorption from the intestine. Similar experiments using the same methods have now been carried out with sodium lactate which was administered continuously in doses of 15–20 mgm. a day subcutaneously. It was found that it shows the same effect as pyruvate does, restoring the low glucose absorption of the adrenalectomized rats to the normal level. (Normal absorption in forty-five minutes, 80·0 per cent of the injected glucose, with adrenalectomized rats 42·3 per cent, after lactate administration 73·7 per cent.)

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[1] Laget, L., *Verh. schweiz. Physiol.*, Feb. 1939.

Relation between the Secretory Cells of the Pars Nervosa of the Hypophysis and Classical Neuroglia

GERSH[1] has shown that the glial cells of the pars nervosa—the pituicytes of Bucy[2]—are responsible for the secretion of the anti-diuretic principle of the posterior lobe. I have presented additional evidence[3] which demonstrates that these cells elaborate the pars nervosa hormones. By the use of silver carbonate methods for neuroglia, developed by the Spanish school, Bucy showed that the pituicytes, like neuroglial astrocytes in the central nervous system, possess cytoplasmic processes, one or more of which end on connective tissue either in the form of pia, of that around blood vessels, or of septa. The pituicytes, however, are impregnated most satisfactorily by methods which demonstrate consistently neuroglial oligodendrocytes (these have cytoplasmic processes but no vascular attachments in contradistinction to astrocytes) and mesodermal microglia. Astrocytes are usually not impregnated by these methods.

In order to establish a clearer concept of the relationship between pituicytes and neuroglia, I have compared the morphology, genesis, and cytoplasmic inclusions of pituicytes with those of neuroglia.

From this study it has become evident that (*a*) pituicytes possess the distinct, ovoid cytoplasmic inclusions (gliosomes) characteristic of astrocytes and oligodendrocytes, but which are absent from microglia; (*b*) pituicytes, like astrocytes and oligodendrocytes, are spongioblastic in origin, being derived from the ectodermal supportive spongioblasts which line the lumina of the infundibular cavity and its extensions in the pars nervosa. The name 'pituiblast' is proposed for those spongioblasts which have quitted the ependymal epithelium and are migrating out to, and implanting attachments (foot plates) on, the peripheral connective tissue. Since oligodendrocytes are derived from those spongioblasts which never acquire foot plates, it follows that pituicytes are more closely allied to astrocytes. They are totally unrelated to mesodermal microglia. It appears, then, that pituicytes, astrocytes and oligodendrocytes constitute a closely inter-related morphological, but not functional, unit.

It is interesting to note that Nageotte[4], Mawas[5], and Achúcarro[6] have attributed glandular functions to neuroglia. The evidence is not conclusive, but the fact that one group of the glial unit—pituicytes—has endocrine functions, renders the hypothesis more plausible.

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April 25.

1 Gersh, *Proc. Soc. Exp. Biol. and Med.*, **37**, 395 (1937).
2 Bucy, *J. Comp. Neurol.*, **55**, 505 (1930).
3 Griffiths, NATURE, **141**, 286 (1938); *Proc. Linn. Soc., N.S.W.*, **63**, 81 (1938).
4 Nageotte, *C.R. Soc. Biol.*, **68**, 168 (1910).
5 Mawas, *C.R., Soc. Biol.*, **69**, 45 (1910).
6 Achúcarro, *Trab. Lab. Invest. Biol. Univ. Madrid*, **11**, 187 (1913).

Points from Foregoing Letters

FROM a study of the correlation between indexes of solar activity and the critical frequences of the F_1 region of the ionosphere, W. M. Goodall concludes that a monthly average character figure based on radio observations gives a reasonably good measure of solar activity.

The position occupied by the activating atoms in the crystal lattice of certain impurity-activated phosphors has been studied by the X-ray method by H. G. Jenkins, A. H. McKeag and H. P. Rooksby. In the case of zinc orthosilicate, for example, the addition of manganese causes a displacement of the X-ray lines which corresponds to a lattice expansion, and the lattice change is of the kind to be expected from the replacement of zinc atoms by manganese atoms.

J. T. Randall and M. H. F. Wilkins describe experiments on the photoconductivity and luminescence of uranyl salts, tungstates, and a number of compounds activated by manganese. The results give direct evidence of the existence of excitation states in these solids.

S. S. Ballard reports the spectrographic analysis of the total ash content of three species of arthropods. Nineteen metallic and semi-metallic elements were encountered during the investigation. A correlation between metallic composition and the feeding habits of insects is suggested.

From the results obtained in three balloon flights, S. Ziemecki concludes that oscillations of ionization found by G. A. Suckstorff in the higher troposphere are due rather to instrumental faults than to substances of extra-terrestrial origin. The anomalies found by J. Juilfs in the lower troposphere are likely to be due to radioactive substances of terrestrial origin.

The variation with temperature of the specific heat of potassium dihydrogen phosphate shows, according to W. Bantle and P. Scherrer, a strongly marked anomalous increase at the upper Curie point.

By the method of trial and error, the crystal structure of diphenyldiacetylene has been roughly determined by E. H. Wiebenga. A refinement of the parameter values will follow by the application of Fourier synthesis.

A new technique for determining centrifugal stresses in rotating disks by means of the photo-elastic method is described by R. E. Newton. The disk is made of Bakelite (BT-61-893), heated to 115° and allowed to cool while rotating at constant speed. In this way the photo-elastic optical effects are 'frozen in' and can be observed in polarized light when the disk is at rest.

Holger Madsen confirms Morot's statement that rabbits form two sorts of faeces, one of which is formed during the night and swallowed like pills directly from the anus. The difference of consistency is due to an intestinal rhythm in the rabbit itself. E. L. Taylor also confirms Morot's statement that the pellets found in the rabbit's stomach are of faecal origin; he considers it to be an outstanding example of physiological refection and thinks that its function may be the digestion of cellulose. He also directs attention to the important bearing which the observation has upon the interpretation of metabolism experiments carried out in the rabbit.

L. Harrison Matthews and Bryan H. C. Matthews find that infra-red rays produce no response in the retina of the tawny owl, and that the cornea, lens and humours transmit so small an amount as to be opaque to the rays for visual purposes. From direct experiments on the eye, they find no confirmation for the suggestion that in darkness owls can see infra-red radiation from animals on which they prey.

E. D. Goldsmith points out that thus far he has been unable to produce supernumerary hydranths in *Hydra* by either laceration of the tissue, local applications of ethyl alcohol, or micro-cautery. These techniques had previously yielded supernumerary heads in planarians.

By painting mice with petroleum ether or alcohol extract of roasted food, E. M. P. Widmark found that adenocarcinoma of the mammary glands was produced in a much higher frequency than the total incidence of spontaneous mammary cancer.

L. Laszt finds that sodium lactate restores the normal glucose absorption from the intestine of adrenalectomized rats in a similar way as was found previously for pyruvate.

Research Items

Anthropometry of Syrian Males

MEASUREMENTS, as well as other observations of 1483 Syrian males, have been made by W. M. Shanklin (*J. R. Anthrop. Inst.*, **68**, 2, 1938). Syria has been a battleground of the nations from time immemorial. Of the invasions of the mountains less is known than of those of the coastal regions; but within historic times one large mountain group, the Druzes, has migrated into southern Lebanon and the Jebel Druze in the Hauran. Like the coastal plain, the desert border has been frequently invaded. Question is raised whether the living races of to-day show traces of their complicated ancestry, and if there is any correlation between the diverse geographical areas and population. In this study the material is examined from the point of view of the religions represented and geographical areas—Shiite Moslems, Sunni Moslems, Christians, and Alouite and Druze, secret sects with Moslem origins. The geographical areas are mountain, desert-border, and desert. Summarizing the results of 15 measurements and 6 indices, as well as the other observations, it is shown conclusively that there are significant differences between the mountain groups and the desert border groups, while both of these differ from the Syrian Bedouin. The major differences are a progressive lengthening of the head, and a decrease of the sephalic index (maximum, Mitwali, 87; minimum, Rwala, 75), in passing from the mountain region to the desert border and the desert. Other changes in the same direction are a progressive narrowing and lengthening of the face and a lengthening of the nose. Convex noses, rarely seen in the desert, are frequently found in the other groups. There is also a progressive darkening of the skin towards the desert, and an increase in the percentage of blood-group *O*. The line of cleavage for Syrian racial differences is thus along geographical and not religious lines. The nomadic peoples of the desert are clearly Mediterraneans in the larger sense. The border peoples represent a transition to a brachicephalic stock, which cannot be considered 'Armenoid'.

Boat Oculi Survivals

IN a further study of the survival of oculi on boats, Mr. James Hornell records additional examples from Portugal, the coasts of the Mediterranean, Madagascar, Zanzibar, the Swaheli coast of East Africa, and the Far East (*J. R. Anthrop. Inst.*, **68**, 2; 1938). In Portugal its use, though lingering in the fishing centres, is on the decline. There are several distinctive substitutes for the oculus, the most common being a star, usually five-pointed. Apart from these substituted devices, the same type of oculus with minor variations occurs along the whole coast line of Portugal south of the Tagus. The custom was encountered nowhere on the Spanish coast except at Malaga. In Sicily and in Malta the oculus is in common use as a device against the evil eye. In the Adriatic the true oculus is rare, though it does occur; but a large red disk on each bow is common around Venice. At ports lower down the coast the oculus is supplanted by a comma-shaped wooden boss on each bow. No trace of the oculus is found in the Red Sea or Persian Gulf, owing to observation of the precepts of the Koran against representation of the human figure, or parts of it. It is only when the Swaheli coast is reached that the oculus is again encountered. Here the *mtepe*, the only indigenous sea-going craft, and many of the small craft of Pemba and Zanzibar are 'eyed', and commonly the eyes are duplicated in the stern. In Mayotte, the island nearest to Madagascar, the oculus is common, both on the bows and the quarters. In Madagascar itself the oculus, not found on the outrigger canoes, occurs on vessels of typical Arab design and on two-masted coasters of lighter type. Omitting India, where the oculus has already been noted, it appears in Burma, but has disappeared in Indonesia and the Malay Peninsula, where the Mohammedan religion has spread. It appears to have occurred sporadically in Selangor and Sumatra, and continues to flourish in Bali. An old tradition is preserved with fidelity in Botel Tobago. The statement made previously that the oculus is universal on the Chinese junk is incorrect. It is never seen on the boats of northern China.

Population Problems in the United States

THE Population Association of America arranged a symposium on "Intrinsic and Environmental Factors in American Population Growth", which was held at the American Philosophical Society, Philadelphia, in November 1938; and the results have recently been published (*Proc. Amer. Philos. Soc.*, **80**, No. 4) as a series of papers by leading American students of population questions. The contributions include "Agriculture and Current Population Trends" by Conrad Taeuber, "Social Environment and Population Growth" by Warren S. Thomson, "Intrinsic Factors in Population Growth" by Frank W. Notestein, "Psychological Factors and Fertility" by John C. Flanagan, "Childlessness" by Clyde V. Kiser, "Cultural Patterns in Rural America" by C. C. Taylor, "Reflections of an Anthropologist on the Future of Population" by H. L. Shapiro, "Population Study and Related Sciences" by A. J. Lotka. The whole constitutes a valuable survey of population trends and problems in the United States, supported by extensive statistics on many points. These statistics are frequently derived from special investigations. Among the conclusions which emerge are the importance of contraception in lowering the birth-rate and the fact that the birth-rate has declined below the replacement level. In the professional group the reasons for family limitation are mainly financial, the cost of higher education and the health of the wife. One writer concludes from results derived from questionnaires that contraception is not responsible for any major share of *permanent* childlessness. The population is expected to reach its peak by 1980. There was a considerable movement back to the land during the depression years 1930–35. Migration from farms has taken place not only in regions where agriculture is non-commercial, but also in areas where commercial agriculture is dominant. In the latter areas smaller families appear to be a part of the culture complex.

Phosphorylations in the Cell

H. KALCKAR (*Enzymologia*, **5**, 365; 1939) has shown that accumulation of phosphoric acid esters takes place in fresh kidney extracts under aerobic conditions so long as suitable concentrations of sodium fluoride are present. These esters do not normally accumulate owing to the activity of phosphatases, of which a group—the 'acid' phosphatases—are poisoned by fluoride. Fluoride, however, diminishes the respiration and this must have an inhibitory effect on the synthesis of the esters, which depends partly on the respiratory activity of the tissue. The specificity of the enzymes involved is shown by the facts that addition of α-glycerophosphate inhibits only the phosphorylation of glycerol, whilst the addition of hexosediphosphate inhibits only the phosphorylation of hexoses. M. Silverman and C. H. Werkman (*Enzymologia*, **5**, 385; 1939) observe that phosphorylation of vitamin B_1 to form cocarboxylase takes place when a suspension of propionic acid bacteria (*Propionibacterium pentosaceum*) is incubated for two hours at 30° C. in a medium containing hexosediphosphate and synthetic vitamin B_1.

Nitrogen-containing Substances of the Intestines

K. RI (*J. Biochem*, **29**, 265; 1939) examined the large intestine and duodenum of healthy adult dogs for nitrogen-containing substances with the following results. The amount of choline, humine, purine-nitrogen, arginine, leucine, valine, isoleucine, phenylalanine and aspartic acid contained in the muscle layer of the duodenum was found to be larger than that of the muscle layer of the large intestine. The amount of glutamic acid and serine, however, contained in the duodenum was less than that of the large intestine. The duodenal mucous membrane was found to contain more choline, arginine, histidine, tyrosine, glutamic acid and glycocoll than the mucous membrane of the large intestine, and more humin, alanine and isoleucine were found in the mucous membrane of the large intestine than in that of the duodenum. Experiments showed that the chemical constituents of the digestive organs were distributed quantitatively, differing somewhat according to the various regions. Histidine, for example, was found in abundance in the duodenal mucous membrane and isoleucine in the duodenal muscle layer and in the mucous membrane of the large intestine.

Hypoglycæmia and Anoxæmia

H. E. Himwich, S. J. Martin, F. A. D. Alexander and J. F. Fazekas (*Endocrinology*, **24**, 536; 1939) studied the activity of the autonomic system of dogs during hypoglycæmia and anoxæmia. Electro-cardiographic changes showed that in both conditions an initial transitory sympathetic influence was followed by parasympathetic predominance. This increased activity of the autonomic nervous system was associated with a depressed metabolism of the brain, as indicated by diminished cerebral utilization of oxygen. It is concluded that with depression of the brain metabolism the predominant and ultimate effect on the autonomic nervous system was a release of parasympathetic influence.

Alimentary Canal of Molluscs

THE structure and function of the alimentary canal in different groups of molluscs have already been dealt with in several accounts in recent years. This work is continued in a communication by Dr. Vera Fretter who has investigated these problems in the Tectibranchs, *Philine aperta*, *Scaphander lignarius*, *Haminea hydatis* and *Actaeon tornalis* (*Trans. Roy. Soc. Edin.*, 1939). All these have radulæ, but the last has no odontophore so that the method of feeding is similar. *Actaeon* also differs from the others in lacking a pair of salivary glands which secrete a fluid containing an amylase and a glycogenase. Again, this species lacks a crushing gizzard. The stomach of all of them has a bilobed digestive gland opening into it; this produces a proteolytic enzyme with an optimum of *p*H 6·3 and a diastatic enzyme and a glycogenase with an optimum between *p*H 6·3 and *p*H 7·0 and a lipase. These enzymes produce soluble products and small particles which are ingested by the digestive cells of the digestive glands wherein digestion is completed. The gland exhibits a cyclical series of changes which includes secretion, and in *Philine* and *Scaphander* the latter phase of activity is associated with the expulsion of excretory matter. This gives rise to a characteristic type of fæcal pellet. As in Gastropods purines tend to replace urea, it is suggested that in this group a terrestrial mode of life is preceded by a uricotelic metabolism.

Neocomian Cephalopods of India

THE Cephalopoda of the Neocomian Belemnite beds of the Salt Range are described by Dr. L. F. Spath (*Palæont. Indica*, N.S., **25**, No. 1, pp. 154, pls. 25; 1939). They are found condensed into the basal beds or lower part of the Belemnite marls, and include eighty-one species of ammonites and three of belemnites; of the former only seven can be definitely identified with species already known; the latter belong mainly to the genus *Hibolites*. The ammonites show that the deposit is of Infra-Valanginian and Valanginian age, and indicate the existence of six zones, but the succession does not appear to be complete. They belong mainly to the families Olcostephanidæ, Berriasellidæ and Neocomitidæ, and their affinities are with the fauna of the great equatorial belt (Tethys and extensions). The author believes that the distribution of oceans and continents was already essentially the same as at the present day, except for the more extended Tethys, and he visualizes an equatorial zone extending 45° of latitude north and south of the equator. While the fauna of the Belemnite beds consists essentially of cephalopods, it includes also a few representatives of reptiles, fishes, brachiopods, pelecypods and one gasteropod.

Greenkeeping Research

THE spring number of the Journal of the Board of Greenkeeping Research (St. Ives Research Station, Bingley, 3*s*. 9*d*. post paid, 1939) contains an account, by R. B. Dawson and N. L. Ferguson, of the production of the St. Ives strain of creeping red fescue grass. This strain is a propagation of a uniform population of *Festuca rubra genuina* var. *glaucescens*, selected from sea marsh turf at Cark in Cartmel, Lancashire. The new strain offers greater leafiness and density of growth than existing commercial strains of the same species, and it has also good winter colour and reasonable resistance to fungal disease. Much of the St. Ives Station's work has centred around the treatment of lawns with appropriate fertilizers; but R. B. Dawson and R. B. Ferro show that this is inadequate without mechanical aeration

by scarification. A paper on the Belfast Airport, by S. P. Mercer and P. A. Lineham, describes some fascinating ecological transformations from dredged mud to turf which can support a load of four tons per square foot. The original soil had a salt content of about 0·4 per cent, and its relative acidity was *p*H 8. Many species of grass were tried upon the drained soil, but a mixture of 40 parts by weight of perennial ryegrass seed to one part of yellow suckling clover gave the best results. Sowings of *Poa maritima* were also used for initial colonization of bare mud. The interesting and complex life-history of an oil beetle, *Meloe proscarabæus*, is also described by Miss B. Lovibond. The species does not seem to cause much trouble upon lawns, except the distaste for its occasional presence in large numbers.

Melanism in Pheasants

THE two inter-fertile species of pheasant, *Phasianus versicolor* and *P. colchicus*, are subdivided into about 42 subspecies. The origin of one of these, sometimes called *P. colchicus* mut. *tenebrosus*, the black pheasant, is uncertain. J. H. Bruckner (*J. Hered.*, **30**, 45–52; 1939) has reported some interesting breeding results. Melanism is dependent on one incompletely dominant gene. The F_1 hybrids between melanic pheasants and the common ring-neck pheasant, *P. colchicus*, are remarkably similar in the distribution of markings to *P. versicolor*. Bruckner suggests that *P. colchicus* may be the older or 'wild type', and that natural selection has selected the least melanic types to produce *P. versicolor*. Modifiers of melanic distribution are known in *P. colchicus*, and hybrids between melanic forms and *P. colchicus* range greatly in the amount of melanism.

Earthquakes during March 1939

ACCORDING to E. Peterschmitt, of the Bureau Central Séismologique de Strasbourg, there were a hundred earthquakes and strong tremors recorded by people and instruments during March 1939. There was not a day on which no earthquake was experienced somewhere in the world, and the greatest number on any one day was eight, on March 17. Of the hundred shocks recorded seventeen were of sufficient strength to have the epicentre determined accurately either by isoseismal lines or from instrumental recordings. Probably the strongest was on March 20, on the Island of Kiou Siou, Japan, and the next in order of magnitude were March 1, strength V, near Ebingen, Jura Souabe; March 5, strength V, La Cote-Saint-Andre (Isere, France); March 12, strength V, Province of Aquila, Italy. These were closely followed by March 20, strength IV, Barcelonnette (Hautes Alpes, France), and Susa (Torino, Italy), epicentre Mont Viso, 44·6° N., 7·1° E.; and March 30, strength IV, in the Ossam Valley.

Coastal Fogs in Scotland

A COMPARISON between the frequency of fog in each month of the year at Scottish lighthouses and inland observing stations in the period 1925–34 and similar data for the period 1889–1900 discussed by Buchan, is the subject-matter of Professional Note No. 88 of the Meteorological Office, by F. E. Dixon. The procedure at lighthouses is to log the number of hours on each day during which, in the opinion of the lightkeeper, there is sufficient atmospheric obscurity to necessitate the sounding of a fog signal, and the personal equation is a factor. At the climatological stations, on the other hand, a more important disturbing factor is the seasonal variation of the time of sunrise in relation to the morning hour of observation. As the period between sunrise and one or two hours after sunrise is a critical one in regard to early morning fogs due to cooling of the lower atmosphere by radiation, this disturbing factor is apt to give rise in fog statistics to a spurious seasonal variation due to the fact that in winter the common hour of observation of 9 h. G.M.T. is favourably placed for the observation of this class of fog, whereas in summer it is much too long after sunrise and will have allowed most of the fogs to have cleared away as a result of prolonged sunshine. It appears from a chart (Plate IV) showing the average annual fog duration at the lighthouses in 1925–34 as a percentage of the average for the earlier period, that 1925–34 was in most areas much the least foggy; but when considering the exceptions, it is clear that these arise mainly because of increased industrial activity, resulting particularly in an increase of winter fogs so great as more than to counteract the general tendency, due to meteorological causes, for the 1925–34 period to be less foggy. This is particularly well shown in the Firth of Forth, and the Moray Firth, where the prevailing winds carry atmospheric pollution from industrial areas out to sea. The tendency for fogs with clear skies to thicken just after sunrise owing to an increase in pollution is well shown by the observations at fixed hours at Aberdeen, where the average number of fogs in 1927–36 increased from 0·4 to 7·0 between 7 h. and 9 h., whereas in summer the corresponding figures were 2·6 and 1·1.

Mechanism of Formation of Polythionic Acids

H. Stamm and H. Wintzer have shown (*Ber.*, 71, 2217; 1938) that the primary product in Wackenroder's reaction (the reaction between hydrogen sulphide and sulphur dioxide in aqueous solution with formation of polythionic acids) is thiosulphurous acid, $H_2S_2O_2$. Although this compound cannot be isolated, its chemical nature can be investigated by the aid of the hydrolysis of dimethyl thiosulphite. In a further communication (*Naturwiss.*, **27**, 317; 1939) the authors conclude that the reactions of this substance which are important as regards the formation of polythionic acids are the following: $H_2S_2O_2 \rightarrow H_2S + SO_2$ (1); $H_2S_2O_2 + H_2S \rightarrow 3S + 2H_2O$ (2); and $H_2S_2O_2 + 2HI \rightarrow I_2 + 2S + 2H_2O$ (3). These reactions proceed quantitatively under suitable conditions. Reactions (2) and (3) show that the thiosulphurous acid is a powerful oxidizing agent. In order to study the reactions of the acid without reaction (1) occurring, it is necessary to work in a non-aqueous solvent, and for this purpose anhydrous formic acid was chosen. It was thus possible to show that the first reaction is reversible. When dimethyl thiosulphite was hydrolysed by hydrochloric acid in the presence of sulphurous acid in the correct proportion, tetrathionic acid was formed quantitatively, the equation being $H_2S_2O_2 + 2H_2SO_3 = H_2S_4O_6 + 2H_2O$. With excess of sulphurous acid and at *p*H 6·0, trithionate and thiosulphate are formed in equal proportions: $S_4O_6'' + SO_3'' = S_3O_6'' + S_2O_3''$. If in this reaction the sulphurous acid is replaced partly or completely by thiosulphuric acid, higher polythionic acids are formed, including hexathionic acid. Once formed, the polythionic acids do not react with the thiosulphurous acid. It will be seen that these reactions offer a satisfactory explanation of the formation of polythionic acids in Wackenroder's solution.

Photochemistry of Colour Vision

By Prof. F. Weigert and J. W. Morton*, University of Glasgow

SOME years ago[1], we prepared 'artificial retinæ' by imbedding in thin gelatin films the pigments extracted from frog retinæ. When such films were exposed to coloured light, they exhibited a typical phenomenon called 'colour selectivity', and it appeared probable that a similar process might account for colour vision in the living eye. As a result of colour selectivity, a preferential increase in transparency is developed for the wave-length of the exciting light, so that there is a minimum for this wave-length in a curve showing extinction plotted against wave-length. The effects are extremely small, and can be detected only by a special microphotometric device. This is based on the production of photodichroism in light-sensitive solid films which have been exposed to polarized light[2].

In the case of the artificial retina, the photodichroism is generally negative[3]. Its distribution through the spectrum can be measured very precisely by means of a good polarimeter with a monochromator. Colour selectivity occurs when the photodichroism has its minimum at the wave-length of the exposing light. It is of advantage to express colour selectivity diagrammatically as a maximum of negative photodichroism.

In previous experiments, solutions of sodium cholate were used for the extraction of the retinal pigments, but recent researches on the photochemistry of visual purple suggest that it is better to extract the pigments by solutions of digitonin[4] or digitalin[5]. In the experiments here reported, crystalline digitalin (kindly presented by Mr. A. M. Chase) was used for preparing gelatin films from frog retinæ. Since the dyestuff of the retina is imbedded in a film of large surface and small thickness its absorption is extremely small, but the change of absorption due to the exposure of the film to polarized light can easily be determined. The general technique of the preparation, exposure and inspection of the artificial retina was the same as described in previous papers[2,3].

*Brang Steel Scholar, University of Glasgow.

The main results of the new experiments agree with those published previously, with one exception. While the inspection of the artificial retina prepared with sodium cholate revealed unspecific after-effects which proceeded in the dark and destroyed the specific colour selectivity[1], these after-effects did not occur when digitalin was used for the extraction of the pigments. Accordingly, it is now possible to expose the same part of the film several times and to study the effects of increasing periods of exposure on the phenomenon. Its general feature can be described as an increase of photodichroism after a certain period of induction and a fading away after longer exposure. The phenomenon therefore is confined to a limited exposure interval on a time-scale.

The upper section of Fig. 1 shows the shape of the photodichroism curves which correspond to the illumination of the artificial retina with polarized light of narrow spectral range, purified by means of Christiansen filters. Because the maxima of these graphs coincide with the wave-lengths of the pure spectral colours which were used for the exposure, they may be termed 'colour graphs'. Each colour graph is qualitatively distinguished from any other colour graph. They cannot be transformed into each other by simple quantitative operations. The same holds true for the psychological sensation of colour. A colour graph therefore may be defined as an expression of the manner in which the artificial retina perceives coloured lights; for example, colour graphs with maxima at 650, 580 or 490 $\mu\mu$ correspond to 'red', 'yellow' and 'blue' in common language.

The lower section of Fig. 1 contains colour graphs which are produced by light of mixed colours purified by ordinary colour filters which are transparent for a large continuous part of the spectrum. The wave-length noted in Fig. 1 is the dominant wave-length which matches the coloured light of the carbon arc used throughout the experiments, after passing through the filter. It is noteworthy that the colour graphs are nearly identical with those for pure monochromatic light although, for example, a yellow filter transmits the total spectrum except the blue. The graph for white light has its maximum at 530 $\mu\mu$.

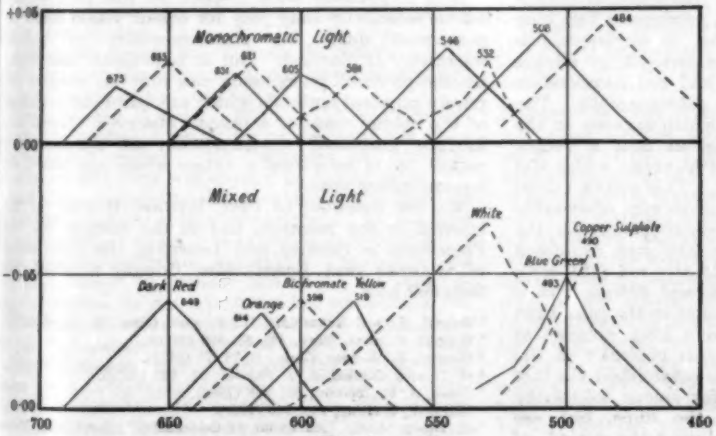

FIG. 1.

This means that the artificial retina shares the inability of the eye to distinguish between different spectral compositions of light with the same dominant wave-length. On the other hand, the inspection of coloured light by a spectroscope shows the spectral composition of the light, but it gives no idea of its 'colour'. The artificial retina has the colour system of a normal trichromat.

Further information about the artificial retina can be obtained from Fig. 2. Black lines

represent the limited time intervals of existence of the colour graphs for monochromatic lights (1–11) and mixed coloured lights against a logarithmic time-scale of exposure. λ (exp.) means the exposing wave-length or, in the case of mixed light, the dominant wave-length; λ (obs.) the wave-length for the maximum of the colour graph. The last column shows in hundredths of a degree the direct readings of photodichroism at the analyser of the polarimeter; 0·01° corresponds to a decrease of extinction by 0·00015 or to an increase of transparency by about 0·03 per cent. This means that the effect of colour selectivity is far below the limit of normal photometric precision.

Two time intervals of existence occur for the colour graphs, which are distinctly separated from each other, and are due obviously to a 'fast' and to a 'slow' photochemical process. The fast process accounts for the colour graphs from blue to orange and the slow process for orange to red, with some overlapping near 600 μμ. A provisional explanation is the existence of *two* photosensitive pigments in the retina which may account for the fast and slow processes. *Both* exhibit the property of colour selectivity, but up to the present, nothing can be anticipated as to whether these pigments are identical with rhodopsin and the recently discovered iodopsin[4].

It can be seen from Fig. 1 that the values of the maxima of the colour graphs are invariably of the same order. This is obviously due to the fact that the pigments are highly diluted in the artificial retina and that they are completely exhausted even by weak radiation. The colour graph records, therefore, the hue typical of a coloured light. The effect of intensity and brightness is being studied. It appears probable that the existence in the retina of two light-sensitive pigments with the properties revealed by these experiments, plays a part in the 'Purkinje phenomenon' and certain colour vision anomalies.

The colour graphs corresponding to mixed lights (Fig. 2, 19–21) which the eye sees as mixed hues require some comment. Purple (19) which is always perceived as a dichromatic hue, produces a fast blue and a slow red colour graph. No. 20 corresponds to a pink which was produced from red (12) by adding some white light. The white and red components are recorded separately by the colour graphs. The mixture of red and green (21), which appears to the eye as whitish-yellow, produces at first a yellow colour graph at 585 μμ, a spectral range which did not occur in the exposing light. This yellow colour graph was followed by white and shortly afterwards by a red colour graph. The colour graphs for the single lights from which the yellow was composed correspond to the green (16) and the red (12), with the dominant wave-lengths 500 and 650 μμ. It is noteworthy that the red component in the pink light which contained some white light (20), appears as a 'fast' process, while pure red is typically in the 'slow' series. These experiments established the fact that the systems responsible for colour selectivity are not originally present in the films, but are produced by the light itself during the period of induction. Further research is in progress and will be published in due course. The examples with mixed lights demonstrate that the artificial retina distinguishes between pure and impure lights in the same way as does the eye. A hue which appears to the eye as composed of two 'valencies', for example, red and blue for purple, is recorded by two separate colour graphs.

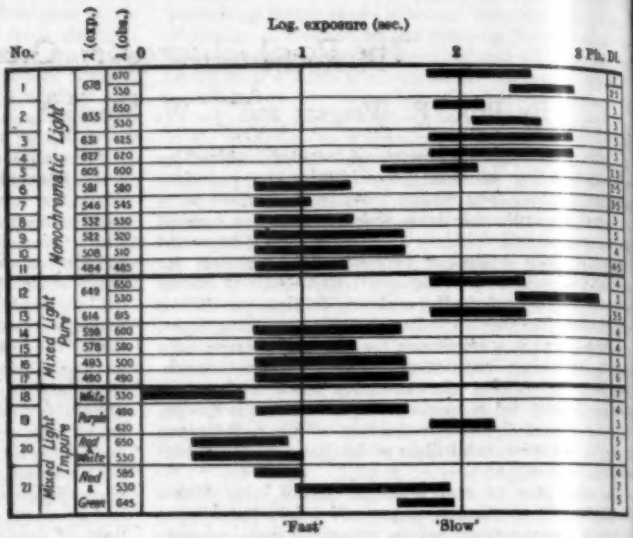

FIG. 2.

Pure dark or mixed red lights of a spectral range, or of a dominant wave-length, longer than 650 μμ (Nos. 1, 2, 12) is followed on continued exposure by a graph with a maximum at 530 μμ which does not occur in the exposing light. This slow process is distinguished from the fast process for green or white to be expected at that wave-length. No physiological phenomenon corresponds to this colour graph, but there are indications that it has its origin in an unspecific bleaching of visual purple, which cannot be observed during the state of high light adaptation required for the perception of dark red hues.

Any hypothesis with respect to the part which colour selectivity may play for colour vision must be postponed until the photochemistry of colour selectivity is clarified. But it is evident that some psycho-physical phenomena can now be studied by purely physical methods which are quite independent of the colour sense of a human observer. Even the modern graphical representation of chromaticity makes use of tri-stimulus values which are based on human colour vision[7].

We are indebted to Prof. Edward Hindle for his interest in the research, and to the Society for the Protection of Science and Learning, the University of Glasgow and Lanarkshire County Council for financial help.

[1] Weigert, F., and Nakashima, M., *Z. phys. Chem.*, B, 7, 25 (1930).
[2] Weigert, F., *Ann. Phys.*, (4), 63, 689 (1920).
[3] Weigert, F., *Z. phys. Chem.*, B, 18, 73 (1932).
[4] cf. Tansley, Katharine, *J. Physiol.*, 71, 442 (1931).
[5] Chase, A. M., *Science*, 87, 238 (1938).
[6] Wald, G., NATURE, 140, 545 (1937).
[7] cf. Hardy, A. C., "Handbook of Colorimetry" (Cambridge, Mass., 1936).

The Royal Observatory, Greenwich

Annual Visitation

THE annual visitation by the Board of Visitors of the Royal Observatory, Greenwich, presided over by the president of the Royal Society, took place on June 3, when the Astronomer Royal, Dr. H. Spencer Jones, presented his report for the year ending April 30, 1939. The report includes the following sections: instruments and apparatus; astronomical observations; time service; Nautical Almanac Office; magnetic observations; meteorological observations.

Transit Circle Observations. The programme for laying the foundations of a system of right ascensions with the new reversible transit circle has been continued. Since its inception in 1937, 4,333 transits have been observed; 1,501 collimations and 1,975 levels were taken in the course of these observations. Intensive observations have traced the main cause of the diurnal changes of collimation to small temperature differences between the micrometer screw and the eyepiece box, amounting sometimes to 2° F. Similarly, changes of level appear to be due largely to temperature differences between the two piers of the instrument, arising from unequal shielding in the case of any wind that is not due north or south. The adopted collimation and level errors are now derived from smoothed curves drawn through the values given by the observations; drift in the clock error has thereby been practically eliminated.

The Airy transit circle has been devoted chiefly to the observation of the sun, moon and planets. The Greenwich observations of the sun from 1750, combined with observations made at other observatories and used in conjunction with observations of the moon and Venus and of the transits of Mercury, form the data for investigating the changes in the rate of rotation of the earth. The results are being communicated to the Royal Astronomical Society.

Cookson Zenith Telescope. 283 plates were taken for the determination of latitude variation. A definitive discussion of the observations for the years 1911–1936 is in the course of publication.

28-inch Refractor. The new comparison-image micrometer continues to prove superior to the filar micrometer, especially for the measurement of the closer double stars.

Thompson Equatorial, 26-inch Refractor. 1,238 plates for parallax determinations were secured and 38 parallaxes entirely completed.

Yapp 36-inch Reflector. With the slitless spectrograph the colour-temperature programme was completed in September. The discussion and detailed results for 250 stars will shortly be in the press.

The slit spectrograph has now taken the place on the telescope of the slitless spectrograph. In addition to experimental work, a provisional programme has been started, consisting of one-prism exposures, for the ultra-violet, on yellow and red giant spectroscopic binaries, to see whether a hot companion can be detected in this region of the spectrum even though its lines are smothered at longer wave-lengths.

Photoheliograph and Spectrohelioscope. A daily series of photographs (begun in 1874) has been secured, in collaboration with the Cape Observatory and Kodaikanal Observatory, for the measurement of sunspot positions and areas. There are indications that the peak of the maximum phase of the 11-year cycle has been passed. Eleven very large spot groups appeared during the year; in seven cases, a magnetic storm occurred within a few days of the respective times of central meridian passage. Examination of the sun's disk is made in hydrogen light ($H\alpha$) to detect the sudden occurrence of bright eruptions which show a relationship with ionospheric irruptions. Observations also include photometric measures of hydrogen disk markings and of prominences at the sun's edge.

Time Service. The official time services have been regularly maintained. The principle of employing a number of clocks as a 'mean clock' has been further extended and has proved of great assistance. The astronomical determination of clock error was made on 114 nights with a reversible transit instrument. The quartz crystal clock constructed at the National Physical Laboratory has been installed. The performance of the Westminster clock ("Big Ben") showed that, while on 16 days the error was greater than 1s., on 188 days the error did not exceed 0·5s. During the year, 4,170 chronometers and watches were received and 3,662 issued. The stock of chronometers and watches now held at the Observatory is being decentralized.

Nautical Almanac Office. During the year, the work of the Office has been mainly devoted to the routine calculation and publication of the *Nautical Almanac*, the *Abridged Nautical Almanac*, the *Air Almanac* and the *Astronomical Navigation Tables*. A working unit is being organized to deal with special investigations that frequently arise. A special supplement to the *Almanac* for 1940 will give data required in the design of instruments and their final adjustment. The paths of the ionospheric and corpuscular eclipses of October 1, 1940, have been published.

Magnetic Observations. A set of La Cour instruments for quick-run recording (3 mm. to the minute) has been added to the equipment at Abinger. The mean values of the magnetic elements for 1938 are:

Declination West, 11° 1·4′
Horizontal Intensity, 0·18522 gauss
Vertical Intensity, 0·43050 gauss
Inclination, 66° 43·2′

Magnetic activity during the year was considerable, five great storms and twenty-three small storms being recorded. The disturbance of the earth's magnetic field at Abinger by artificial fields due to electric traction is stated to have become increasingly serious as the electrification of the Southern Railway has extended. Disturbance (5 γ to 10 γ) is continuous throughout the working hours and ceases only during the interval 1h.–5h. civil time. The complexity of the total effect makes identification of the separate origins ordinarily impossible. The installation of the La Cour quick-run magnetograph has provided evidence, however, that significant effects occur coinciding with the movements of trains in the neighbourhood of Guildford as well as of Dorking. In the last few months, field investigations of the effect of electric traction have been made near

Chichester, at Itchenor and at Selsey. At the latter site, seven miles from the nearest point of the railway, disturbance was quite distinct, although seldom amounting to 1 γ in vertical intensity.

Staff. The post of chief assistant, rendered vacant by the appointment in the previous year of Mr. W. M. H. Greaves to the post of Astronomer Royal for Scotland, has been filled by Dr. H. R. Hulme, fellow of Caius College, Cambridge.

In concluding his report, the Astronomer Royal states the concern he feels regarding the steady deterioration of observing conditions at Greenwich. Long-exposure photography is no longer possible owing to the increasing brightness of the sky at night. As a result of atmospheric pollution by smoke, programmes of work which used to be successfully undertaken at Greenwich are now impracticable. The actual definition of stellar images has also suffered. In addition, there are various forms of fouling, the two most serious being the deposit of grit and the destruction of aluminized surfaces. The pivots and Y's of the new reversible transit, although carefully protected, already show appreciable scoring. There is a permanent risk of damage by grit to the objectives of all the Greenwich telescopes. "If the Royal Observatory is to continue to make important contributions to astronomy as it has done for the past 264 years, and to provide an efficient time service of high accuracy, it is essential," the report continues, "that it should be removed to a site where astronomical conditions are favourable. The present wasteful efforts to secure observations under increasingly bad conditions, and the restrictions of programmes that are necessitated by such conditions, would thereby be avoided."

Finally, as regards the Abinger magnetic station, the general level of artificial disturbance is now such as to render all observations difficult, and when the disturbances are at their worst the observations lose much of their value. The removal of the magnetic observatory to another site has therefore become a necessity. The choice of a new site for such work in the south of England appears limited to a few regions in Devonshire.

The report concludes with the statement that proposals for the removal of the whole of the astronomical work from Greenwich and of the magnetic work from Abinger to new and more favourable sites are under consideration.

Historical Survey of Mycology*

UNLIKE the treatment of flowering plants, so far as Linnæus was concerned, the subject of mycology had scarcely begun before his time. It is true that many fungi were mentioned by the classical writers but most of the interest in them was derived solely from their gastronomic effects. Their origin puzzled certain writers who regarded them as the result of the fermentation of the earth; truffles, on the other hand, were supposed to be due to the action of lightning. Herbals were based on classical authority: in 1593 Cesalpino wrote suggesting that fungi were not plants and were spontaneously generated.

Towards the end of the sixteenth century, Porta recognized the spores of such dark-spored forms as *Coprinus* and possibly of the mycetozoan *Fuligo septica*; but he thought they were seeds.

The arrival of the microscope was necessary before any progress in mycology could be made; but even then progress was slow. Hooke, in his "Micrographia", devoted two sections to fungi, and his description of the rose blight, *Phragmidium*, was accompanied by an illustration which is the first known diagram of a microscopic fungus. Hooke's views on fungi were thus expressed: "First, that Moulds and Mushrooms require no seminal property, but the former may be produc'd at any time from any kind of putrifying Animal, or Vegetable Substance, as flesh, etc., kept moist and warm.... Next, that as Mushrooms may be generated without seed, so does it not appear that they have any such thing as seed in any part of them; for having considered several kinds of them, I could never find any thing in them that I could with any probability guess to be the seed of it, so that it does not yet appear (that I know of) that Mushrooms may be generated from a seed, but they rather seem to depend merely upon a convenient constitution of the matter out of which they are made, and a concurrence of either natural or artificial heat." In spite of accumulation of knowledge, similar ideas on the fungi extended over the following century and a half.

Malpighi, writing during 1675–79, described certain fungi in which he interpreted the sporangiophore as an inflorescence and the spores as florets. Thus, Hooke favoured the spontaneous origin of fungi, whereas Malpighi favoured the origin from seed.

Apart from Leeuwenhoek's observations on yeast in 1690, the next step was the recognition of the mycelium or spawn of mushrooms. Tournefort, in 1707, gave the first account of mushroom-growing, and described the mycelium. Still further speculative theories of the origin of fungi appeared, until in 1729 P. A. Micheli published what may be considered as the first real step in our knowledge of the fungi. He made many morphological observations of first importance, but was actually still looking for flowers and seeds in the fungi examined. He also proved that what we now know as spores gave rise to new fungi similar to the plants from which they were taken. But in spite of Micheli's work, most botanists gave up the fungi as hopeless, and even Linnæus in his "Philosophia Botanica" of 1751 wrote: "The order of Fungi is still Chaos, a scandal to art, no botanist knowing what is a species and what a variety."

Misled by the observations of Baron O. F. Munckhausen, Linnæus, in the twelfth edition of his "Systema Naturæ" described a genus "*Chaos*" with six species; the species "*C. Fungorum*" showed the metamorphosis of zoophytes from vegetables into animals and vice versa. "*C. Ustilago*" is the modern *Ustilago* which infects grains of cereals, grasses and certain florets. "*C. infusorium*" contained various Protozoa. The genus was rightly named, and thus did Linnæus sadly come to grief.

John Ellis, who had a long correspondence with

* From the Presidential Address delivered to the Linnean Society of London, by Dr. J. Ramsbottom, O.B.E., on May 24.

Linnæus on the subject, carried out a series of observations and finally convinced himself that the spores of fungi, like seeds of flowering plants, were unrelated to the animalculæ which appeared when they were placed in water. But others, incuding Sir John Hill, persisted with Munckhausen's theory.

Necker, in 1783, published a treatise expounding the view that fungi were like plants in their method of nutrition, development and growth, but that they differed in origin. He therefore regarded them as a new kingdom between minerals and animals and proposed for it the name *Regnum mesymale*—the intermediate kingdom. Villement also proposed a new class for them, namely, pseudo-zoo-lithophytes.

Discussion on the origin of fungi which had been rife ended in 1783, and the conception of spontaneous generation was finally exploded by Pasteur, whose forerunners in this field of thought were Redi and Spallanzani.

In 1784, Hedwig published his classic work on cryptogams, in which he proposed the use of the name 'spore' for the reproductive structures of these plants. In 1837, Léveillé announced that spores are essentially different from seeds since they do not contain embryos. Hedwig's work was incorporated in the general mycological structure by Persoon, to whom was due perhaps more than to anyone else the foundation of systematic mycology. During 1815–74, the recognized authority on the classification of the fungi was Elias Fries.

The highly complex pleomorphy of the rust fungi took a long time to unravel, although heteroecism was much to the fore because of the damage caused by the rust of wheat. Heteroecism was proved conclusively in wheat by de Bary in 1865, while Oersted, in the same year, independently proved heteroecism in *Gymnosporangium* on junipers and pears.

The important part played by fungi in causing diseases of plants was obvious so soon as it was realized that mildews, etc., were fungi.

Training of Teachers

A DETERMINATION that teachers, as a body, should not be inferior to other professions in respect of their education and training led the National Union of Teachers to undertake two years ago an investigation of the whole question of the training of teachers and the grants available for the purpose. The investigating committee, composed of six members of the Union's executive and six representatives of university training departments, of training colleges and of secondary schools, completed its work last February, and the report* has been published in the form of a book of 360 pages including a summary of the principal conclusions formulated in 95 articles. These range over a wide field, including recruitment and placing as well as training. Although a number of the recommendations concern the content of training courses, the committee regarded such things as internal matters for the training institutions. In a preliminary chapter a strong case is made out for requiring some actual experience of teaching practice *before* admission to a training institution, this being desirable less for its intrinsic value than as a test of aptitude for the career of a teacher, for it is notorious that many recipients of grants for training have no such aptitude nor even any serious desire to take up teaching as a profession. It is proposed to make an officer of the local education authority report on the teaching potentialities, personality and general suitability for the teaching profession of every applicant for a place in a university training department or training college.

The vital importance of teaching practice as part of the college or university course is also emphasized and it is mainly to provide adequate opportunities for this that the report recommends the lengthening of the course to three years as a minimum. The report is equally emphatic as to the influence of residential conditions during the years of training, and proposes that residence in a college or hostel should be compulsory for all and that funds should be provided for ensuring that hostels are run on the right lines as recommended by the University Grants Committee in its last quinquennial review.

Above all, the committee was concerned to press on towards the ideal of "a unified profession to serve a unified system of education", implying for the teacher trained in a training college a status equivalent to that of the university graduate. To this end it is proposed to develop the connexion between training colleges and universities so that the former may eventually become integral parts of the latter. On the crucial question of the staffing of training colleges the report observes that salaries are inadequate and prospects of promotion relatively small but leaves it at that, the additional grants it proposes for training colleges being intended to enable them to reduce the fees payable by students, not to make possible a higher standard of qualification and status for the staffs. It quotes with approval a suggestion that the staffs might be strengthened by the addition of two or three experienced practising teachers seconded for a definite period of years.

The report concludes with a paragraph on the need for immediate investigation by the Board of Education. Should such an investigation be made, it is to be hoped that the fundamental importance in this connexion of the progress of science will be recognized. The progress of science and its application has brought about changes which should affect the training of teachers both in respect of science teaching and as calling for a change in the attitude of all teachers towards science. Progress is so rapid that science teaching in schools is bound to lag hopelessly behind and be correspondingly ineffective unless it is kept constantly under review by competent observers, and modified and readjusted whenever necessary, and unless examining bodies are compelled to take cognizance of such changes. On the other hand, the social and economic transformations resulting from it are so sweeping that it is of the first importance that science should form an integral part of the curriculum of the primary as well as the post-primary school and that all teachers should grasp the relations of science teaching to the teaching of other subjects. The question is discussed in Prof. Bernal's recent book on "The Social Function of Science".

*The Training of Teachers and Grants to Intending Teachers. Being a Report of a Committee of Investigation appointed by the Executive of the National Union of Teachers and adopted by the Executive on 3rd March 1939. Pp. xxxi+328. (London: National Union of Teachers, 1939.)

Science News a Century Ago

Heating and Ventilation of Public Buildings

A CENTURY ago much attention was being paid to the heating of both domestic and public buildings, and stoves of many kinds were being placed on the market. Patents for steam-heating apparatus had been taken out in the eighteenth century, and at the same time the hot-water heating system had been adopted for various purposes. At a meeting of the Institution of Civil Engineers on June 11, 1839, the subject was dealt with by Charles Hood in a paper entitled "On Warming and Ventilating Public Buildings and Apartments, with an account of the methods which have been most successfully employed in insuring a healthy state of the Atmosphere". In this paper he described the constitution of the atmosphere, the artificial changes produced in it and the effect of those changes upon annual economy. He pointed out the consequences of heating by very hot iron surfaces, or by a 'hot air cockle', and said that the systems of Mr. Bernharat and Dr. Arnolt were open to the same objections. Referring to the use of the more moderate heat of steam or hot water in pipes, he said the latter was the more economical and simple plan. The amount of heating surface depended on the building, but an approximate rule for a public building was its cubic contents divided by 200 to give the square feet necessary to maintain a temperature of 55° to 58° in the coldest weather in Great Britain. When speaking of ventilation, he said that the amount of air to be changed was 3½ cubic feet per minute per person. Natural ventilation through openings in the ceiling was the best for ordinary purposes, but in all extraordinary cases ventilation by mechanical means was the only efficacious method.

Trigonometrical Survey of India

ONE of the papers read at the Astronomical Society on June 14, 1839, was entitled "Some account of the progress of the Trigonometrical Survey now carrying on in India, extracted from the Correspondence of Colonel Everest". During the earliest operations the stations were the highest points of the mountains or hilly land; but a new district was about to be traversed where such advantages did not exist. This district, described as the Doab, was a country devoid of all natural elevations, but having mounds which appear to have been raised by the native inhabitants. For the operations in the Doab, Col. Everest contrived masts 70 ft. high, from the top of which by means of a bamboo staff an ignited blue-light was raised still 20 ft. higher. The site he chose for a base line was at Dhera Dun, near Sisee Bara on the verge of the Asan River. He had a complete set of compensation measuring rods like those used by Colonel Colby in Ireland. During his observations he had encountered some extraordinary phenomena of refraction; in many instances the distant heliotrope, instead of exhibiting a round disk, appeared in the form of a tall column. His possession of the compensation bars had induced him to re-measure the base line at Seronge which he had measured in 1825 with a steel chain, and his experiences led him to the opinion that it would be necessary to revise the whole of Colonel Lambton's work before it could be joined on to the series of triangles recently completed with the new instruments.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, **208**, 1257–1368, April 24, 1939).

M. MOLLIARD: New researches on the production of tubercles on potato in an aseptic medium.

H. DEVAUX: Remarkable relation between cellular constitution and 'wettability' of mosses.

C. EHRESMANN: Topology of simple closed groups.

H. HOPF: Topology of closed Lie groups and their generalizations.

P. HEBRONI: Linear differential equations in a ring of certain continued matrices (hyperbolic matrices) and their applications to certain integro-differential equations.

N. OBRECHKOFF: Zeros of some polynomials.

J. MARCINKIEWICZ: Interpolation of operations.

L. BERS: An integral representation of biharmonic functions in domains possessing an observable boundary surface.

P. COUDERC: Luminous aureoles of novæ.

C. SĂLCEANU and H. MCCORMICK: New method for the determination of the surface tension of liquids, based on the weight of falling drops.

E. BAUMGARDT: Measurement of certain adiabatic elastic constants of crystals, by the ultrasonic method.

MLLE. A. DAMMANN: Analysis of musical sounds. Sounds of different instruments have been recorded by a cathode ray oscillograph; the results have analysed by a Coradi harmonic analyser.

M. PARODI: A phenomenon of the propagation of waves. Application to thermodynamics.

O. TE-TCHAO and H. LE BOITEUX: Coefficient of absorption of small ions by neutral particles suspended in air.

M. ROUAULT: Fourier analysis of the diffraction of electrons by free molecules.

C. S. PIAW: Absorption spectra of salicylic acid and of its alkaline salts in aqueous solutions.

P. ROUARD: A phase change of 2π in [optical] metallic reflection.

S. S. LU, C. HUNG-CHI and L. TA-YUAN: Influence of pressure on photographic sensibility to X-rays.

G. DUPOUY and C. FERT: Magnetic rotatory power of heavy water. Dispersion and variation with heat.

MLLE. C. CHAMIÉ: Grouping of atoms of radio-colloids.

T. SAN-TSIANG: Groups of protons emitted during bombardment of hydrogenous substances by α rays.

V. KOSTOMAROFF: Influence of 'chemical tensions' and size of grain on the magnetic properties of pure iron and of a silicon-iron.

MLLE. S. VEIL: Introduction of further solutes into aqueous potassium iodide, and electrostatic effects.

E. DARMOIS and MLLE. M. THÉODORESCO: Raman spectrum of neutral molybdates, in the crystalline state and in aqueous solution.

M. BALLAY: Properties of some aluminium bronzes with beryllium.

MME. P. RAMART-LUCAS: Structure and absorption of hydroxylated colouring matters derived from triphenylmethane; existence of two coloured isomeric forms of phenolsulphophthaleins and of phenol phthaleins.

D. BODROUX and R. THOMASSIN: Some derivatives of *ortho-* and *para*-cyclohexylphenols.

R. QUELET and J. DUCASSE: Chloroalcoholation of *para*-propylanisol; application to the synthesis of some derivatives.

R. PAUL: Action of Raney nickel on alcohols; probability of combination of the catalyst with hydrogen receptors.

R. LOMBARD: Contribution to the study of pyroabietic acids.

Z.-C. GLACET: Condensing reductions [in organic chemistry].

J. H. BRUNN: New observations on the south-west border of the Albano-Thessalian fold in Greece.

J. LUGEON: An integrating altimeter for aerological sounding.

A. ARNULF, R. BERNARD, D. CAVASSILAS and G. DÉJARDIN: New description of the spectrum of the night sky in the ultra-violet region.

G. DEFLANDRE: The 'stephanoliths', representatives of a new type of coccoliths of the Upper Jurassic.

P. DANGEARD: Some new marine algæ of western Morocco.

MLLE. M. FOURCROY: Non-continuity of the internal generating zone of young roots.

R. SOUÈGES: Embryogeny of the Polemoniaceæ; development of the embryo in *Polemonium cæruleum* L.

R. GAUTHERET: Measurement of the growth of tissues of carrot cultivated *in vitro*.

G. GUITTONNEAU and MLLE. S. HAAS: A *Sporotrichum* agent of normal maturation of certain cheeses.

M. RANGIER and P. DE TRAVERSE: Urinary glycuronic acid and urochrome.

L. DAUTREBANDE: An anti-gas filtering cannister of high neutralizing capacity and responding to the exigencies of respiratory physiology.

R. CATALA: Acceleration by shock of the metamorphosis of caterpillars of *Chrysiridia madagascariensis* Cram. (Uraniidæ).

A. VANDEL: Researches on the genetics of *Armadillidium vulgare* (Latr.) in relation to monogeny.

A. PEYRON: Homologies between the embryonic vesicles of the human ovum and those of the parthenogenetic *embryomes*.

J. LOISELEUR: Mechanism of the action of diastases of the trypsic group.

J. LAVOLLAY and MME. F. LABOREY: Definition of the coefficient of action of magnesium for *Aspergillus niger*; its variations with the composition of the medium.

R. DUSCHINSKY and J. JEANNERAT: Obtaining natural amino acids, starting from the racemic forms, by means of the *d*-amino-acid oxidase.

MLLE. S. VILLENEUVE-BRACHON: Division and formation of the peristome of *Licnophora* (L. Chattoni n.sp.) [Ciliates, Heterotrichs].

MLLE. G. CORDIER: Adsorption of aphthous virus by bone charcoal and tricalcium phosphate; application to immunization of the guinea pig.

M. PIÉRY, J.-F. MARTIN, J. ENSELME and C. PESCHIERA: Experimental study of the biological influence of a prolonged stay at an altitude; pulmonary modifications. Geese and rabbits were kept at the Jungfraujoch station for six months; hearts of the former show no lesions; of the latter, variable lesions. Lungs are all congested, the iron content being greatest with much congestion.

Dublin

Royal Irish Academy, May 8.

KENNETH C. BAILEY: Retardation of chemical reactions. (9) Choice of retarders in liquid phase oxidations. The results of nearly two hundred investigations of oxidations in the liquid phase have been summarized in tabular form, and the cases in which particular groups of retarders have been found to be successful or unsuccessful have been noted. No substance is known to retard all types of liquid phase oxidation. Deductions have been made as to the retarders likely to be helpful for particular groups of oxidizable compounds, and samples are given of retarders which, having been found of value in certain cases, would repay further investigation.

Rome

National Academy of the Lincei (*Atti*, 28, 283–330, 1938).

E. BOMPIANI: Projective geometry of a homogeneous linear partial differential equation. (1) Classification of the quasi-asymptotics. (2) Invariant systems associated with a system of quasi-asymptotics.

M. VILLA: Quasi-asymptotic curves (2).

T. VIOLA: Limits of an integral in the ordinary form depending on equal and uniform Lipschitz functions with first derivatives.

G. SCORZA DRAGONI: Criterion of existence for a problem of limiting values.

L. GIALANELLA: Heterochromatic photometry and colour index of the planets Neptune and Vesta.

Tokyo

Imperial Academy (15, No. 3, 69–100, March 1939).

RYOJI SAKATA: A problem concerning transformations of polyhedra to spherical surfaces.

YUKIYOSI KAWADA: Characters of linear groups.

KÔITI KONDO: A proof of Toeplitz of the normal matrix.

AKITUNE IMAMURA: Land deformations and seismic activity in the Mutu-Dewa district.

SHIGEHIKO SUGASAWA, KÛTI SAKURAI and NORIO SUGIMOTO: Synthesis of some 1,2-polymethylenetetrahydro-iso-quinolines. Analyses were executed by Miss K. Serikawa.

HISAKATSU YABE and TOSHIO SUGIYAMA: Discovery of a Mesozoic hexacoral in a green schistose rock of the Kamuikotan system of Hokkaidô.

HARUO KINOSTA: Electrodialytic 'washing' of *Paramecium*. Unlike most living cells, by this method, *Paramecium* can be repeatedly washed in distilled water practically indefinitely, provided that the water is free from oligodynamic impurities.

TADAO YOKOYAMA: Circulation of blood in the silk worm. The generally accepted circulatory course of the blood is disproved.

EIJI FUKUSHIMA: Acenaphthene as a polyploidizing agency. Young archesporial cells are affected by acenaphthene and produce polyploid pollen grains. The polyploidizing value on late archesporial cells and cells in the meiotic stage is much lower.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

ASSISTANT CIVIL ENGINEER ADVISER to the Director of Ordnance Factories, India—The Secretary, Military Department, India Office, London, S.W.1, marking envelope "Ordnance Department" (June 12).

ASSISTANT WORKS MANAGER at the Cordite Factory, Aruvankadu, Madras—The Secretary, Military Department, India Office, London, S.W.1, marking envelope "Ordnance Department" (June 12).

ASSISTANT LECTURER IN GEOGRAPHY in the University of Sheffield—The Registrar (June 12).

WOMAN LABORATORY ASSISTANT at the Horton Malaria Laboratory, Horton Hospital, Epsom—The Director of Establishments, Ministry of Health, Whitehall, London, S.W.1 (June 13).

DEMONSTRATOR (man or woman) IN THE DEPARTMENT OF ZOOLOGY at Bedford College for Women, London, N.W.1—The Secretary (June 15).

ASSISTANTS (III) for compilation and analysis of statistical data in the Directorate of Scientific Research, Air Ministry—The Superintendent, Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk, quoting Ref. C.200 (June 16).

ASSISTANT LECTURER IN ZOOLOGY at Chelsea Polytechnic, London, S.W.3—The Principal (June 16).

HEAD OF THE PHYSICS DEPARTMENT in the Swansea Municipal Technical College—Director of Education, Guildhall, Swansea (June 16).

JUNIOR LECTURER IN CIVIL ENGINEERING in Queen's University, Belfast—The Secretary (June 17).

LECTURER IN THE DEPARTMENT OF PHYSICS, University College of Wales, Aberystwyth—The Registrar (June 17).

LECTURER IN MATHEMATICS in the County Mining and Technical School, Nuneaton—The Principal (June 17).

HEAD OF THE DEPARTMENT OF ENGINEERING AND BUILDING in the County Technical College, Guildford—The Principal (June 17).

LIVESTOCK OFFICER in the Ministry of Agriculture and Fisheries—The Secretary of the Ministry, 10 Whitehall Place, London, S.W.1 (June 19).

LECTURER IN METALLURGY in the Technical College, Bradford—The Director of Education, Town Hall, Bradford (June 21).

LECTURER IN ORGANIC CHEMISTRY in University College, Bangor—The Registrar (June 24).

HEAD OF THE PHARMACY DEPARTMENT of the Central Technical College, Birmingham—The Principal (June 24).

TUTOR (Geography) and a TUTOR (Mathematics) in the Gordon Memorial College, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 marked "Tutor (Geography)" or "Tutor (Mathematics)" respectively (June 25).

TWO RESEARCH OFFICERS (Farm Management and Agricultural Costing) in the Agricultural Economics Research Institute, Oxford—The Secretary of the Committee for Rural Economy, School of Rural Economy, Parks Road, Oxford (July 1).

UNIVERSITY PROFESSOR OF METALLURGY at the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (Jan. 31, 1940).

ASSISTANT ENGINEER (M/5731) for the Malayan Public Works Service and an ASSISTANT ENGINEER (M/5765) for the Drainage and Irrigation Department, Malaya—Crown Agents for the Colonies, 4 Millbank, London, S.W.1.

PROFESSOR OF MINING ENGINEERING and PROFESSOR OF ORE DRESSING in Laval University, Quebec City, Canada—The Secretary, Faculty of Science.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Patents, Designs and Trade Marks. Fifty-sixth Report of the Comptroller-General of Patents, Designs and Trade Marks, with Appendices, for the Year 1938. Pp. 26. (London: H.M. Stationery Office.) 6*d*. net. [175

South Pacific Ocean Currents. Published by authority of the Meteorological Committee and prepared in the Marine Division of the Meteorological Office under the supervision of Capt. L. A. Brooke Smith. (M.O. 435.) Pp. 10. 35 in. × 24 in. (London: H.M. Stationery Office.) 7*s*. 6*d*. net. [175

How to Banish Hay Fever. By William Gilbert Orr. Pp. 32. (London: Orzone (London), Ltd.) 1*s*. [185

Scottish Education Department. Report on the Royal Scottish Museum, Edinburgh, for the Year 1938. Pp. 22. (Edinburgh and London: H.M. Stationery Office.) 4*d*. net. [185

British Trust for Ornithology. Fifth Report, Spring 1939. Pp. 36. (London: British Trust for Ornithology, c/o Zoological Society of London.) [185

King's College: Dove Marine Laboratory. Report for the Year ending July 31, 1938. (Third Series, No. 6.) Pp. 45. (Cullercoats: Dove Marine Laboratory.) 5*s*. [185

The Scientific Journal of the Royal College of Science. Vol. 9: containing Papers read during the Session 1938–1939 before the Imperial College Chemical Society, the Royal College of Science Natural History Society, the Royal College of Science Mathematical and Physical Society. Pp. 137. (London: Edward Arnold and Co.) 7*s*. 6*d*. [196

The Annual Report of the Oundle School Natural History Society. Pp. 38. (Oundle: Oundle School.) [196

Department of Scientific and Industrial Research. The Investigation of Atmospheric Pollution. Report on Observations in the Year ended 31st March 1938: Twenty-fourth Report. Pp. v+117. 2*s*. net. General Deposit Tables for the Year ended 31st March 1938: Supplementary to the Twenty-fourth Report. Pp. ii+124. 4*s*. 6*d*. net. (London: H.M. Stationery Office.) [205

Proceedings of the Royal Irish Academy. Vol. 45, Section B, No. 5: Reports from the Limnological Laboratory, 4: The Phytoplankton of the River Shannon and Lough Derg. By R. Southern and A. C. Gardiner. Pp. 89–124+plates 17–21. 3*s*. Vol. 45, Section B, No. 7: River Liffey Survey, 2: The Food consumed by the Brown Trout (*Salmo trutta* Linn.) in Acid and Alkaline Waters. By Winifred E. Frost. Pp. 139–206+plate 24. 3*s*. Vol. 45, Section B, No. 13: Larval Stages of the Euphausiid *Thysanopoda acutifrons* (Holt and Tattersall) taken off the South-west Coast of Ireland. By Winifred E. Frost. Pp. 301–319. 1*s*. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [225

Other Countries

U.S. Department of the Interior: Office of Education. Vocational Division Bulletin No. 199 (Trade and Vocational Series No. 57): Vocational Training for Firemen. By Frank Cushman. Pp. v+30. (Washington, D.C.: Government Printing Office.) 10 cents. [166

Journées Internationales de Chronométrie et de Métrologie, Paris, Juillet 1937. Procès-verbaux et mémoires recueillis par René Baillaud et Pierre Nicolau. Pp. 740. (Paris: Éditions de la *Revue d'Optique théorique et instrumentale*.) [166

Indian Central Cotton Committee: Technological Laboratory, Technological Bulletin, Series B, No. 26: A Dial Reading Apparatus for the Determination of Fibre Strength. By S. S. Sukthankar, D. N. Ahmad and H. Navkal. Pp. 16. 1 rupee. Technological Bulletin, Series B, No. 27: The Determination of the Swollen Diameter of Cotton Fibres—Effect of Size of Sample on the Significance and Reliability of the Results. By R. S. Koshal and Dr. N. Ahmad. Pp. 12. 8 annas. (Bombay: Indian Central Cotton Committee.) [166

Proceedings of the U.S. National Museum. Vol. 86, No. 3054: Two New Ophiurans from the Smithsonian–Hartford Expedition, 1937. By Hubert Lyman Clark. Pp. 415–418+1 plate. Vol. 86, No. 3055: New Species of Flatworms from North, Central and South America. By Libbie H. Hyman. Pp. 419–440. Vol. 86, No. 3056: Echinoderms of the Smithsonian–Hartford Expedition, 1937, with other West Indian Records. By Austin H. Clark. Pp. 441–456. (Washington, D.C.: Government Printing Office.) [196

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 13: Economic Status of Rural Teachers. By Walter H. Gaumnitz. (Project of Research in Universities.) Pp. viii+96. (Washington, D.C.: Government Printing Office.) 10 cents. [196

Memoirs of the Geological Survey of India. Palæontologia Indica, New Series, Vol. 27, Memoir No. 1: The Mesozoic Brachiopoda of the Bannu District. By Dr. M. R. Sahni. Pp. iv+26+2 plates. (Calcutta: Geological Survey of India.) 1.6 rupees; 2*s*. [225

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 20: Items 4139–4259, October, November, December 1938. By Ernest A. Hodgson. Pp. 405–420. (Ottawa: King's Printer.) 25 cents. [225

Mitteilungen der Naturforschenden Gesellschaft Bern aus dem Jahre 1938. Pp. lix+178. (Bern: Paul Haupt.) [225

Nigeria. Annual Report on the Forest Administration of Nigeria for the Year 1937. Pp. 46. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 4*s*. [225

Punjab Irrigation Research Institute. Research Publication, Vol. 4, No. 10: Dispersion and Stability of Soil Colloids in Water, Part 1: Auto-Disintegration. By Dr. Amar Nath Puri and Manohar Lal. Pp. 8+7 plates. 7 annas; 8*d*. Research Publication, Vol. 4, No. 11: Dispersion and Stability of Soil Colloids in Water, Part 2: Ultra-Clay and the Efficiency of Dispersion Methods. By Dr. Amar Nath Puri, B. R. Puri and Manohar Lal. Pp. 9. 4 annas; 5*d*. Research Publication, Vol. 4, No. 12: The Sodium Carbonate Method of Lining Canals and Water-Courses for preventing Seepage Losses. By Dr. Amar Nath Puri. Pp. 11+4 plates. 4 annas; 5*d*. Research Publication, Vol. 5, No. 8: The Development of the Electrical Analogy to Problems of Flow of Water in Sub-Soil, with Special Reference to the Design of Weirs and similar Structures. By Gurdas Ram and Dr. V. L. Vaidianathan. Pp. 44+88 plates. 1.10 rupees; 2*s*. 6*d*. Research Publication, Vol. 5, No. 9: On the Transmission Constant of Water in Subsoil Sands. By Chanan Singh, Hans Raj Luthra and Dr. V. L. Vaidianathan. Pp. 7+9 plates. 7 annas; 8*d*. (Lahore: Punjab Irrigation Research Institute.) [225

Catalogues, etc.

Die Askania-Warte. Jahrgang 4, Nr. 17, Mai-Juni 1939. Pp. 49–72. (Berlin-Friedenau: Askania-Werke A.G.)

Solar Telescope at Oxford University Observatory. (Reprinted from *Engineering*, March 10 and 24, 1939.) (Publication No. 13.) Pp. 16+1 plate. (Newcastle-upon-Tyne: Sir Howard Grubb, Parsons and Co.)

Catalogue of Books on the Subjects of Geology, Palæontology, Conchology, Entomology, Ornithology, etc. (No. 279.) Pp. 16. (London: Dulau and Co., Ltd.)

Botanik: Zeitschriften, Bücher, Monographien. (Antiquariats-Katalog Nr. 56.) Pp. 232. (Leipzig: Karl Max Poppe.)

Mobile Pumping Units for Vacuum or Pressure. (Mob. 1.) Pp. 4. (London: W. Edwards and Co.)

Deutsche Landes- und Ortsgeschichte: Genealogie und Heraldik. (Antiquariatskatalog Nr. 732.) Pp. 322. (Leipzig: Buchhandlung Gustav Fock, G.m.b.H.)